The MINING CONGRESS JOURNAL

Vol. 12 APRIL, 1926 *No.* 4

Inviting Bids—

on mine cars is just ordinary business. But placing orders for mine cars is as interesting and as important as any other work an official is called upon to do.

Hyatt equipped cars are used by all of the large producing companies, one group having more than ten thousand Hyatt equipped cars. Continued patronage is a true indication that when *"to be equipped with Hyatt bearings"* appears on prints and in specifications that a company is seeking large, low cost production by the use of durable and dependable mine car running gear.

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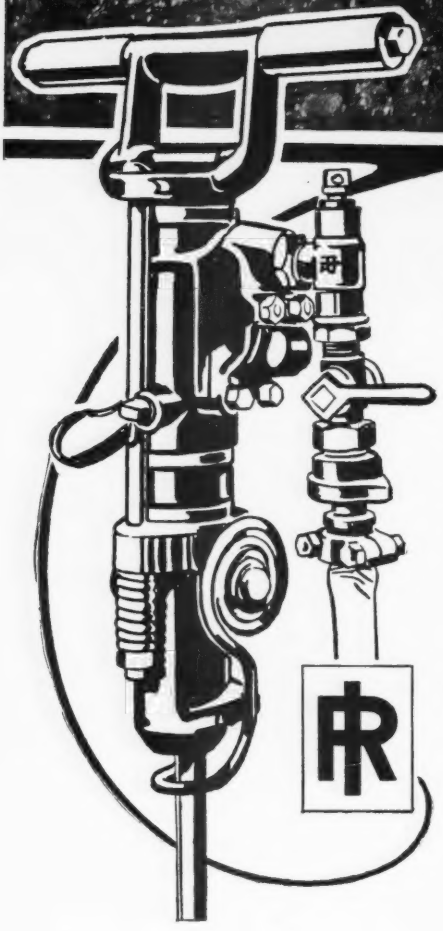

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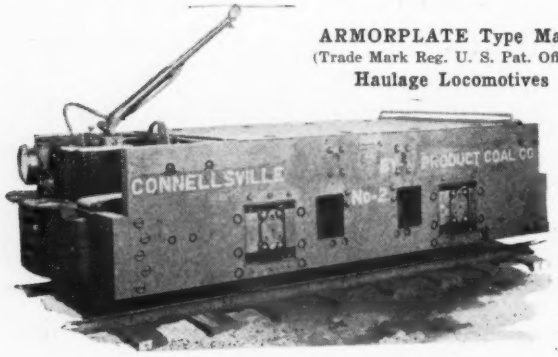

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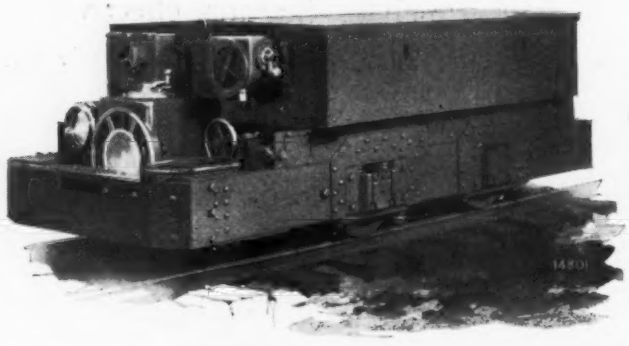

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APRIL, 1926

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PRACTICAL OPERATING MEN'S DEPARTMENT

METALS

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COAL

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Face Conveyors With Concentrated Mining System

Quantity Production Applied To Coal Mining

Installing And Moving Room Conveyors

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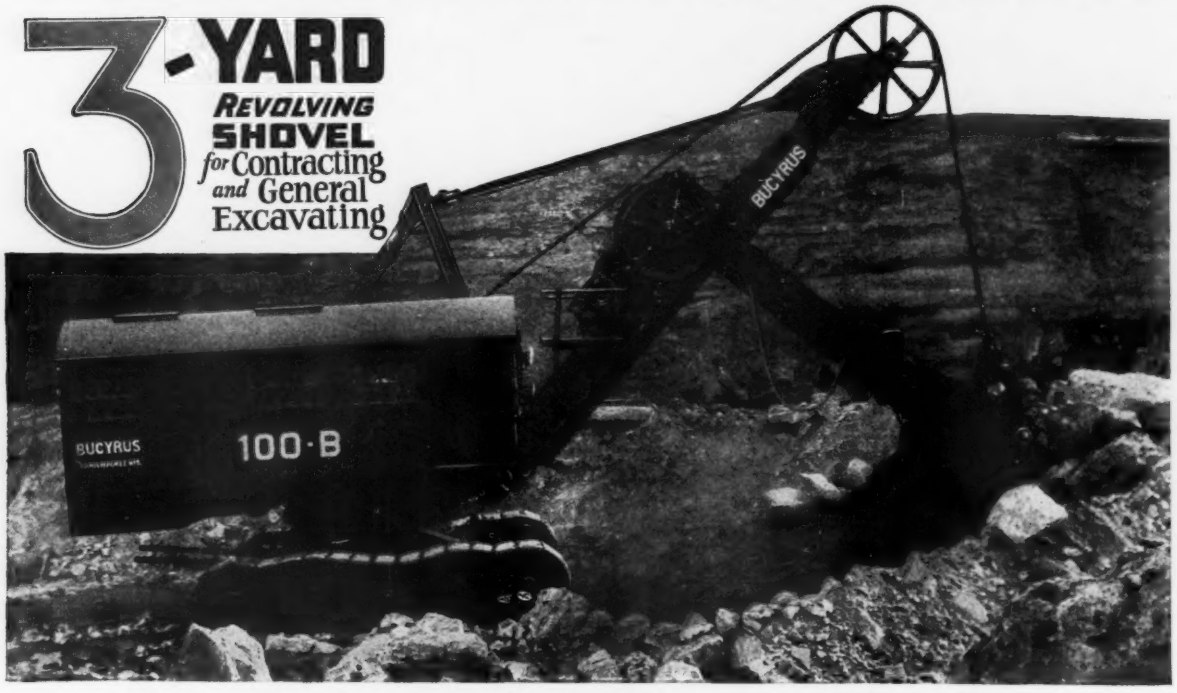

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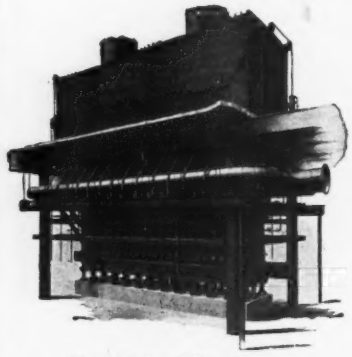

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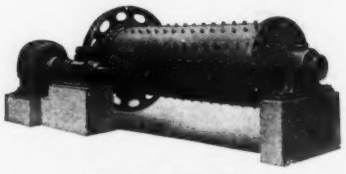

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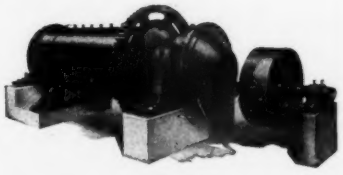
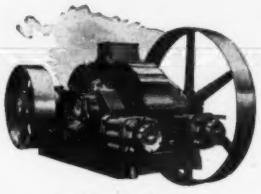


Rod Mill



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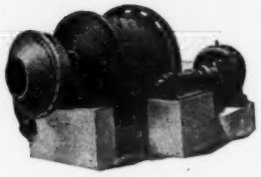

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General Electric supplies equipment for all phases of coal mine electrification. Consider G-E apparatus whenever your requirements are electrical—for G-E installations pay you as surely as good investment bonds. Your nearest G-E office has coal mine specialists always at your service.

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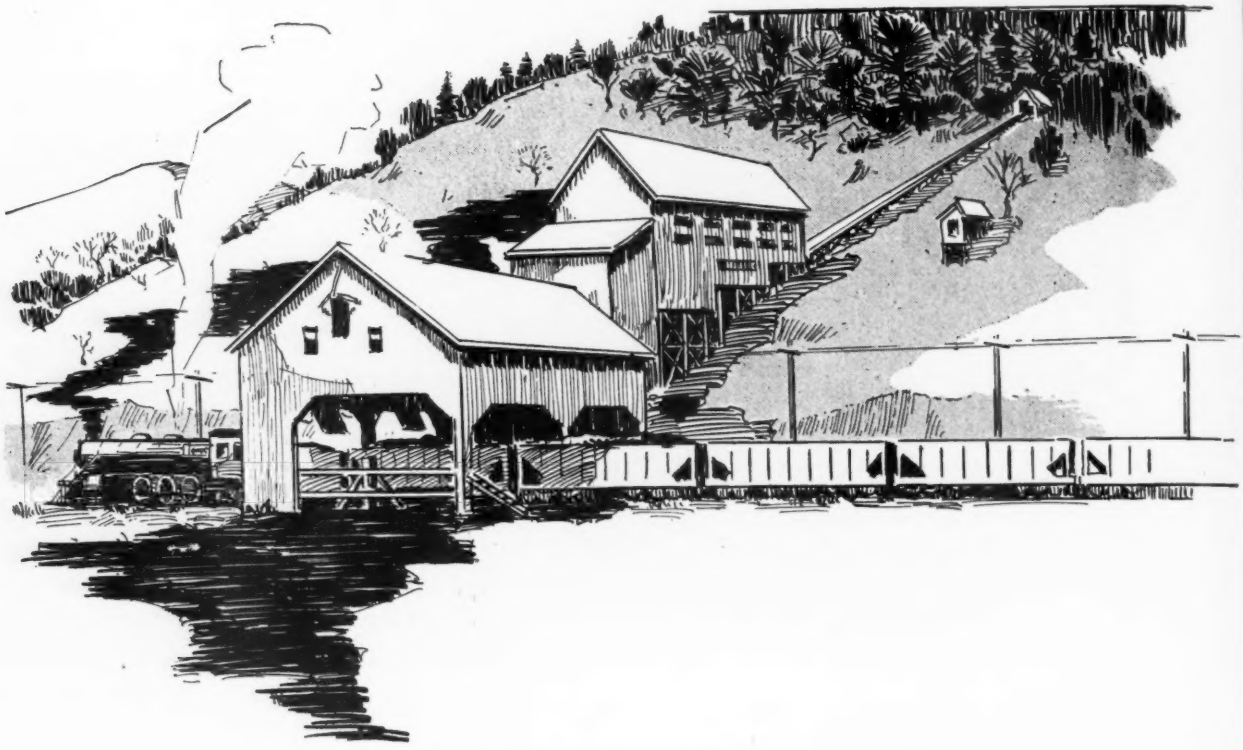

AMONG the States of the Union, Pennsylvania is the oldest and youngest of industrial commonwealths. Oldest, in that within its borders more branches of manufacture have been carried forward generation after generation, than in any other state. Youngest in that it is putting forth each year something new in the field of industry. While the development of the steel industry is the greatest single chapter in the industrial history of Pennsylvania, it is but one of many that make this history the most remarkable of that of the western hemisphere.

Ranking first among the natural resources of Pennsylvania are the deposits of coal, which have been so important a factor in the development of its industries. While the export of coal, both bituminous and anthracite, beyond the borders of the state has been an important element in the growth of material prosperity, the main value of these extensive deposits has been their power to attract and create manufactures.

The KEYSTONE State

Virtually all of the anthracite coal of the country is in Pennsylvania. The anthracite district today occupies an area of 480 square miles and in 1924 the production was 90,214,000 tons. Various estimates have been made as to the length of time that will be required to exhaust the supply of anthracite at the present rate of consumption. It is probable that unless the amount taken out annually is largely increased there will be anthracite in Pennsylvania at least a century hence.

Not only has Pennsylvania these great deposits of anthracite, but it has also the thickest bituminous coal measures. Of the 67 counties in Pennsylvania, 25 produce bituminous coal, the largest being Westmoreland and Fayette counties. In 1908 the mines of Pennsylvania produced more coal than the combined production of all the countries of the world except Great Britain, Germany and Austria-Hungary. It was in that year five times the production of France and seven times the production of Russia. In 1924 it led all the states in the United States with a production of 123,530,000 tons.

Prior to 1880 Pennsylvania was the leader among the states in the mining of iron ore, but since the opening of the great Lake Superior iron ranges there has been a decline in the iron ore production.

Leading the steel works of the state in point of extent of output are those of the Carnegie Steel Company, at Pittsburgh. The Carnegie works furnish to the United States Steel Corporation the steel, in billet or other semi-finished form, for nearly one-half of its finished product, including practically all the steel used by the American Sheet and Tin Plate Company, the American Bridge Company, the steel hoop mills, axle works, and other scattering subsidiaries. It claims the largest output of steel of any single company in the world. 90,000 men are employed in the Pittsburgh steel mills.

High in importance among the elements that go to make up the natural riches of Pennsylvania may be ranked that belt of cement rock in what is known as the Lehigh District, which has made possible one of the most notable of Pennsylvania's industrial developments. The history of this period of development in which the production has gradually expanded until it has reached a total of more than 40,000,000 barrels a year, may truly be regarded as one of the most absorbing of industrial romances. Truly, if this is the "cement age" the Lehigh district is one of the great vital factors of the age.

Rapidly advancing toward the time when 1,000,000 acres of stripped land will be set aside for forest growth within its borders, Pennsylvania is today unquestionably in the lead among the states in the aggressiveness and effectiveness of its reforestation work.

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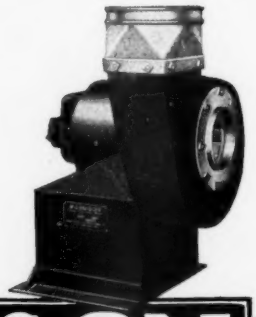

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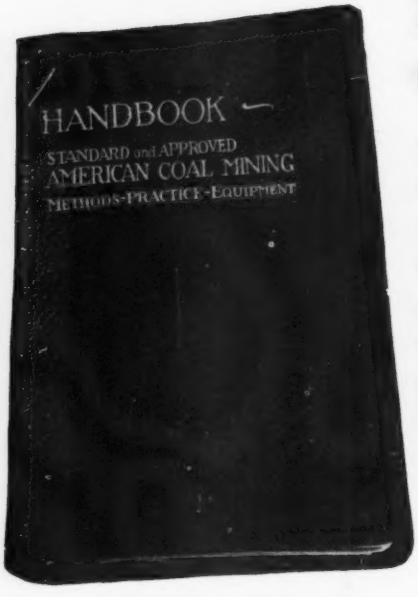

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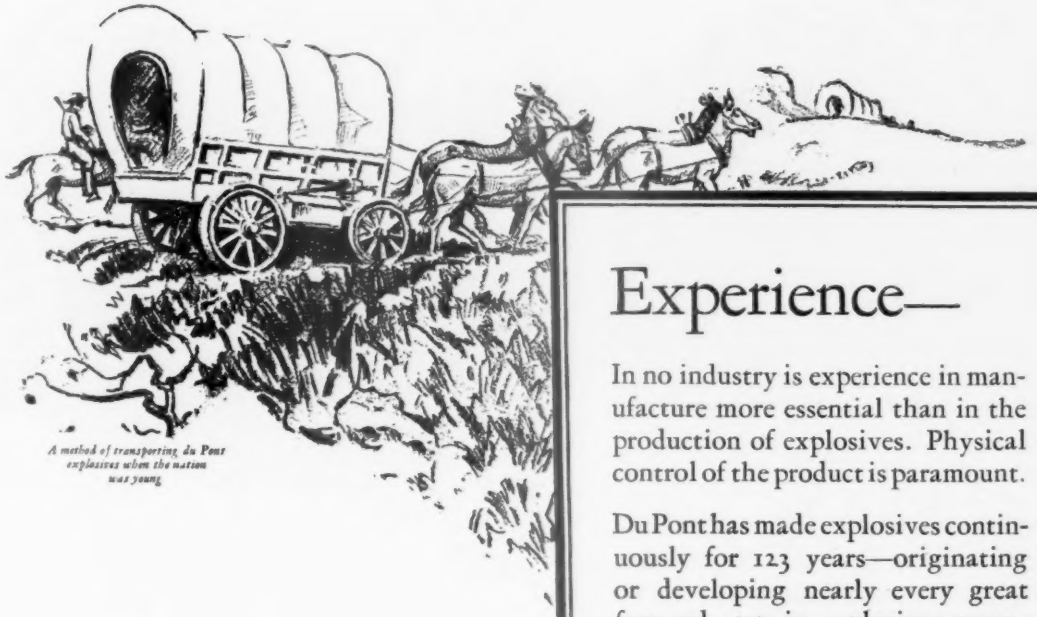

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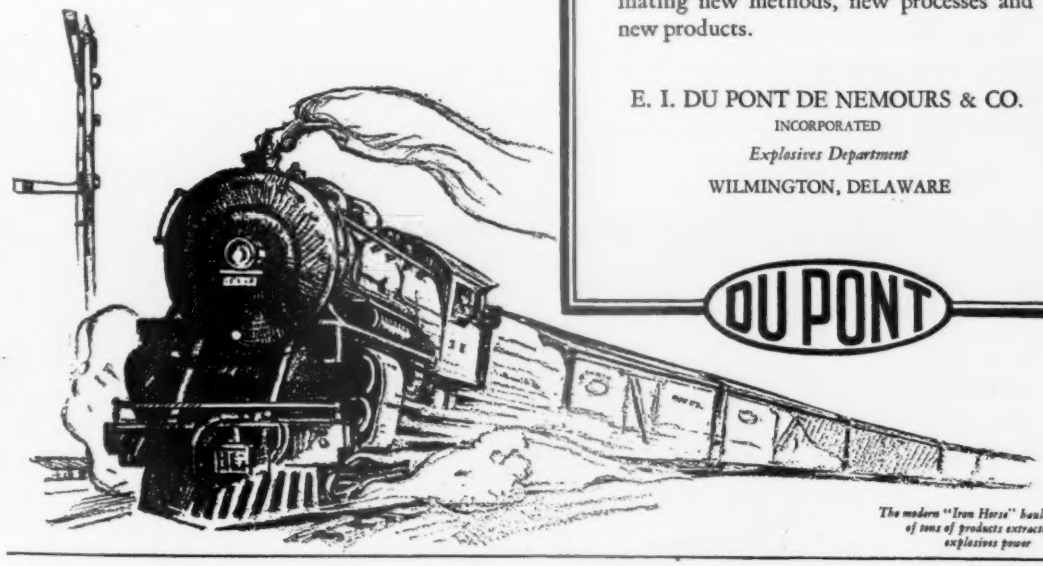

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Mine Drainage—The economic and legal aspects of stream pollution.

Cutting and Blasting Coal—Recent experiences, blasting for mechanical loading, gas cartridges, cushion blasting, cutting in clay bottoms.

Mechanical Loading—Progress, successes and failures, adapting mining systems, providing cars, use in small mines and in thin, flat seams, in rooms and entries.

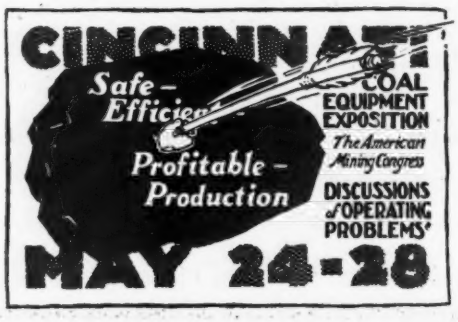
Underground Conveyors—General discussions, successful use, use with mechanical loaders, use of different types, long wall.

Accident Prevention—Proven advantages of rock dusting, sealing fires in gaseous mines.

Roof Control and Mining Methods—Elements, on long faces, long faces with jacks, practice and recent developments.

Underground Transportation—Safety, efficiency and economy of good track, track details and maintenance, car design, control for long haulage.

The STRONGEST PROGRAM EVER PRESENTED TO COAL MEN



The yellow sticker that is the request from the industry that you attend this great convention

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THE SILVER PURCHASE ACT

SENATE bill 756 introduced by Senator Pittman of Nevada providing for the compulsory purchase by the Treasury of 14,589,730 ounces of silver to complete purchases under the original silver purchase act of April 23, 1918, has been favorably reported by the Senate Committee on Banking and Currency. With this report is a minority report in opposition to the bill signed by six Democratic members of the committee headed by Carter Glass who was Secretary of the Treasury at the time the original silver purchase act was passed.

The report opens with the statement that "The real purpose of the legislation known as the Pittman act of April 23, 1918, as may be seen by an examination of the discussion in Congress, was to avert a financial crash in India which, it was thought, would retard if not actually break down our line of communications and supply on the eastern front in the World War."

This statement acknowledges a situation existing at a most crucial period of the great war to the effect that it was then absolutely necessary for Great Britain to immediately acquire a very large amount of silver to stabilize the value of the rupee in India if the prosecution of the war was not to be seriously handicapped.

There was but one place in the world where a sufficient amount of silver was available, viz, in the Treasury of the United States. Lord Reading came to the United States with the expectation of buying this silver which then was the reserve upon which silver certificates were issued and in circulation. The withdrawal of these certificates was necessary in order to release the silver and this could not be done without congressional authority. Except for this requirement Lord Reading's first proposal to buy this silver at the price at which it had been secured by the Government, an average of about 55c, might have been accepted as a measure of reciprocity with an ally in the great war.

Notwithstanding this inducement it seemed but fair that Great Britain should pay for this silver at least the amount which she would realize for it in the form of Indian rupees which was 94 and a fraction cents when the net result of dumping this enormous amount of silver into the world's markets would result in leaving the silver producers' most important market filled for many years to come.

Word was sent to the West from Washington outlining this situation and various meetings were held at Salt Lake and Denver, culminating in the Washington office of the American Mining Congress, December 14, 1917. Other meetings followed at which an agreement was reached that the silver certificates should be recalled, that the silver in the Treasury thus made available should be sold to Great Britain for $1 per ounce and that the Government should replace this silver from mines of the United States at the price received from Great Britain.

A considerable opposition was developed to this plan on the part of some Western Senators, some of whom believed that the silver should be repurchased at the going market price at the time of purchase rather than at a fixed price which seemed then to be less than the probable future market price. In fact, the price of silver thereafter in world markets was advanced to $1.38 per ounce and several large sales were made for even a higher figure.

In view of this situation, it does not seem fair nor in accordance with the facts that the minority report of this committee shall reiterate the statement that "The silver producers have received a total bonus from the Treasury of approximately $58,169,950, representing the difference between the world market price of silver at the time of purchase by the Treasury and the $1 per ounce which the Treasury was required by the Pittman act to pay."

The MINING CONGRESS JOURNAL emphatically asserts that no bonus was paid to the silver producers at any time. The silver producers made it possible for Great Britain to buy their silver in a time of great emergency to the allies and particularly to Great Britain at a fair and reasonable price through the function of the Federal Government.

The representatives of the West in the Congress of the United States consented to the removal of the silver from the Treasury to meet this emergency, providing that silver was re-purchased from their constituents—the silver miners of the West.

The transfer of this silver prevented an Indian revolt which would have created a most serious situation in the prosecution of the World War and which might have cost this country billions of dollars, to say nothing of the additional loss of life. The only cost to the Government to accomplish this important result was the cost of recoining the silver.

The silver miner has had no bonus. He does not ask for a bonus. He asks only that the contract made by the Government with Great Britain for the sale of such an amount of silver as was necessary to save the credit of the British Government shall be carried out in good faith. He bitterly resents the implication that he is being paid a bonus for silver sold at $1 per ounce during the period when the world market price of silver was very much in excess of a dollar.

The Government with the taxpayers' money had accumulated the largest stock of silver in the world and was not permitted to dump this upon the market and thus effectually destroy for many years the market for silver and the industry which relied upon that market. The sale of silver under the Pittman act was a sale of silver from the mines, to which transaction for its own benefit the Government loaned its monetary stock to be replaced from production.

This talk about a bonus to the silver producers is about threadbare when considered in connection with the actual facts.

UNECONOMIC CONSERVATION

THERE is a steadily growing demand in our western states that the Federal Government shall adopt a policy with respect to the development and disposition of mineral lands within the public domain, that will enable private capital and enterprise to make these lands productive. For many years the Government has permitted stock-raising homesteaders and grazing lessees to have practical control of vast areas of the public domain. This has prevented prospecting, exploration and development of public lands classified as subject to stock-grazing homestead entries and lands included in the forest reserves that have been leased for grazing purposes. The Government still retains over 30 percent of the land in the Rocky Mountain and Pacific Coast States. In Colorado Uncle Sam now holds almost 50 percent of the total area of the state in such a manner that it can not become a taxable holding. Thus the State of Colorado is deprived of from one to two million dollars annually in revenue, which otherwise would accrue from the coal, oil and shale lands if they were privately owned.

The national forest areas of the State of Idaho constitute approximately one-third the total area of the state, and lie almost entirely in that region where large potential mineral resources exist. This state ranks second as a lead producer, and is said to contain very promising areas for the discovery of new lead mines. These prospects are almost wholly within the national forest reserves. The bill now before Congress calling for the limitation of mining within the so-called forest reserves to the right of occupancy only has aroused the West to vigorous protest. It is growing increasingly restless under bureaucratic restrictions which have been forced upon it through the leasing law, the public land laws, and the restrictions placed around mining on the public domain. There is a general feeling in the West that the Federal Leasing Law imposes a heavy burden upon the public land states with little compensatory benefits. In many of the western states the Government's policy in extending its forest reserves has resulted in placing the greater part of the mineralized lands and mineral resources in these restricted areas, with its attendant bureaucratic supervision, uncertain and unnecessary rules and regulations, and friction between the miners and Federal officials, which has resulted in a serious handicap in the development of new properties. New mines have not been discovered; new industries have not been developed; workmen are unemployed and the prospector is becoming more and more obscure.

There should be no conflict between the Forest Service and the Mining Industry. Conservation of our forest areas is as necessary as the development of our mineral deposits. A nation without forests is equally as impotent as a nation without minerals. But trees can be replaced, even if it takes a hundred years; while minerals cannot be replaced except by the discovery of new deposits. Although the West is rich in potential mines, the day of easy discovery is passed; and the Government should abandon the red tape with which it has bound the mineral resources within the public domain against discovery, development and utilization and should recognize the fact that the discovery of one mine is of greater economic value to the state and nation than a hundred grazing leases or a thousand stock-raising homesteads that furnish grazing on an average for only one cow to each 30 acres.

THE MAY MEETING

"SAFE, Efficient, Profitable Production," with emphasis on the first word, is the slogan for the annual meeting of Practical Operating Men for the coal industry, which for the third time in as many years is to be held at Cincinnati, Ohio, May 24 to 28.

This meeting, held in conjunction with the National Exposition of Mine Equipment, and under the auspices of the American Mining Congress, has become the mecca for those men charged with the mechanical operation of mines. It is the only meeting of the year that is a combination of practical discussion of every-day problems and a complete visualization of the most modern equipment to be used in the solving of those problems. The convention and exposition are housed in one building, thus combining in the most practical way the discussions and the equipment shown. More than 100 leading manufacturers have already taken space, the entire floor of the exposition being sold 90 days prior to the opening of the convention. These firms will have on display their latest equipment to assist in solving production problems.

The program committee is arranging a program of outstanding importance. This committee represents all of the important coal-producing districts, and has the cooperation of all of the coal associations. It is headed by George B. Harrington, of the Chicago, Wilmington, and Franklin Coal Company, as chairman. Newell G. Alford, of H. N. Eavenson & Associates, is secretary. The committee has 38 representatives. At a meeting held at Pittsburgh on March 20 the following subjects were selected for discussion: Drainage; Cutting and Blasting Coal; Mechanical Loaders; Underground Conveyors; Accident Prevention; Roof Control and Mining Methods; and Underground Transportation. The speakers and discussion leaders scheduled are all men of wide experience in the coal industry. Everything seems to be in readiness for a record-breaking meeting that will have far-reaching results.

Each year has seen a greater growth in mechanical operation of industries. The coal industry faces the dire necessity of cutting costs, if it is to survive. This meeting offers an opportunity to learn how others are accomplishing production in a safe, efficient, and profitable manner. Every coal company that is interested in reducing its costs, that is interested in safety and accident prevention, that is interested in making a profit, should send as many of its men to Cincinnati as can be spared. They should send all of their key men at some time during the five-day discussion, because each day some new phase of practical mining will be up for consideration, and the man particularly charged with that end of the business of producing coal will come back to his job filled with new ideas and with enthusiasm. The coal mine executive will attend this meeting. He will come to learn first hand what his competitors are doing, and he will also understand better the problems his own men are up against.

This convention is a clearing house for troubles. If there is some problem worrying you, come to Cincinnati, tell the convention about it, and perhaps the result will be infinitely greater than you anticipate.

These conventions and expositions are established. They are worth while. In no other way can the industry at such a small expenditure come into such close contact; at no other convention are the avenues so wide for fellowship, assistance, and knowledge.

Remember the dates: May 24-28—Cincinnati, Ohio.

STABILIZATION OF COAL

THE coal operators, the Government and the public unite in wanting stabilization of the coal business. To preserve one of the largest investments in the country, a degree of stabilization must be effected promptly. To give the merchants in coal a reasonable foundation under their business—to protect them against tremendous and quick inventory losses—that stabilization is necessary. And, to restore public confidence in the coal business, the price fluctuations must be confined to much narrower limits than has been the case in the last eight years—another expression of stabilization. The idea of stabilization has been "sold" to the country and to the industry. The next big task is to deliver what has been sold.

As we approach so great a subject, it is inevitable that much day dreaming will be indulged in. As impractical men ballooning even a sensible project, many chimerical schemes are to be expected. Men will insist upon discussing this subject even though their only fitness for it is the possession of a lively imagination. It is that sort of thing which, at the moment, is proving the stumbling block in the path of real stabilization.

One of the greatest handicaps to true stabilization is the attempt of theorists to invent a fool proof device. Many recent discussions have, consequently, centered around impractical methods which the highly practical gentlemen of the coal industry know, at a glance, to be unworkable. For example, some of the so-called stabilization programs have been founded upon the belief that the coal productive capacity should be fixed by some empirical decree and should be robbed of even a capacity to fluctuate. In order to accomplish that, it has been suggested that a survey of the needs of the country be made and that this should result in predetermining the number of mines which are necessary to supply the nation's coal. Any number of mines, therefore, greater than the pre-determined number, should be declared unnecessary.

The instant such suggestions are made, the coal operators retire from the public meetings because they do not want to discourage the whole project. But, when they are alone, they condemn the whole scheme as visionary and lose their interest, measurably, in the main objective. That is, they know that the power to say what mines are or are not necessary is the power, residing in somebody, to say who may and who may not engage in the business. Such a scheme would give, assumptively, to some Washington bureau, the power of life and death over private business enterprises in a privately owned industry.

This power, if granted, would go infinitely further. It would mean that coal—merely because it is coal, rather than some other natural resource—had been, for the purpose of legislation, put in a class by itself. It is interesting to consider such visionary schemes, if only to see to what lengths men will allow their minds to wander on purely practical questions. But, every coal man knows that, in final analysis, the thing will never be allowed to happen.

Of course, it is impossible to go that far. And, to get real stabilization, it is not necessary to go that far. There is a line of cleavage which must be recognized. That is the line which separates regulation from fixation. To express it more nearly in the language of the street, it is the line which separates a situation where a man can make a fool of himself if he wants to, from a situation where the fool is absolutely prevented from carrying out a foolish project. It is the difference between liberty and the straight jacket. The coal people are not willing to be put in a straight jacket.

If we may be allowed to suggest it, the distinction lies in this direction. We have, in this country, a number of gentlemen who think rather highly of themselves. They believe that the coal business would be all right if they were allowed to run it. They want to prescribe all the rules; they want to dictate. The coal men do not want to be run; they do not want to take dictation, at least from those who have no experience in the coal business.

On the other hand, there is possible a routine in the coal business which, if established, would itself work toward the very stabilization which everybody wants. This amounts to no more than the substitution of a new way of doing an old thing for an old way. It takes time, of course, to introduce any new routine. But, when it is once established, it works almost automatically. This routine, leaves to the coal men their liberty and drives them to the proper goal under the influence of enlightened self-interest. It is the latter thing which the coal people want.

REACHING THE GOAL

NO longer is standardized mining equipment the dream of a group of men who saw in such equipment a road to economical production. This issue contains definite standards on frogs and switches, drainage equipment, and tentative standards for drill steel. These are but three phases of equipment out of the 50 or more projects under consideration by the Standardization Division of the American Mining Congress. Previously standards have been submitted covering mine car wheels, mine locomotives, underground power transmission and power equipment, metal mine ventilation, metal mine underground transportation, mechanical loading in metal mines, and mine sampling.

More than 350 mine operators, manufacturers, engineers, and Government representatives have been working together for seven years to give to the mining industry a standard mining code covering methods, practice, and equipment. The first concrete result of their combined effort was the Handbook of Standard Coal Mining Practice, of which there are now in circulation in the coal industry more than 1,700 copies. A similar book is in preparation for the metal mining industry, rendering a similar service to that branch of mining.

The greatest definite result of this work has been the actual adoption by mining companies of these recommendations. There is on file in the office of the American Mining Congress letters from 48 large metal producers to the effect that they are using in every-day performance the standards brought out by the Division. In the coal industry more and more companies are adopting the recommendations for that industry. One large company last year in mailing out specifications for equipment to entirely re-equip their properties definitely specified that the manufacturer should conform to the standards adopted by the Standardization Division.

The accomplishment over a period of but seven years of this comparatively small, unselfish group of men is truly remarkable. A point in instance is that of mine tracks and signals, where the chairman of the committee has been able to secure the cooperation of all of the leading manufacturers of this type of equipment, in making interchangeable their products.

There has been delay in getting the official endorsement of the American Engineering Standards Committee, because of the necessarily cumbersome machinery of such an organization. An industry which operates at

the speed of the mining industry is apt to become impatient with any procedure which must necessarily work as slowly as the Standards Committee. The work is coming along as rapidly as can be expected when approval is sought in harmonious accord from the 25 or 30 mining associations representing various phases of the industry.

The encouraging thing is the adoption of these standards by the industry itself, because any standard to be effective must have the practical application that only the industry itself can give. The standards so far brought out are simple, practical, economical, and simplify production problems to a degree that will pay any company to investigate.

MAKING A CASE

"CONFIDENCE is founded upon reputation, which is the result of experience and achievement."

There have been more than 10,000 bills before the Sixty-ninth Congress in its short existence of four months. These bills have covered several thousands of subjects not in any way related. A member of Congress is expected to vote for or against every measure. To do that intelligently he must be informed upon the subjects they cover.

Obviously no human being can assimilate facts upon even 500 different subjects unless those facts have previously been digested, correlated, and simplified to the *nth* degree, and have behind them such indisputable evidence as to give complete confidence as to their authenticity. Convinced "by experience and achievement," members of Congress learn to rely upon sources of information that have so marshalled their facts as to be impregnable.

Meritorious measures fail in Congress because they have had back of them no strong, well-organized movement, prepared to furnish facts—indisputable, reliable facts. This rule applies not alone to Congress; it is equally true of those who control the policies and procedure of Government departments.

Whenever an industry can make a case that proves the fallacy or injustice of an administrative policy or regulation, that industry generally is given a new deal. There may be a few outstanding exceptions to this rule, but in the main the statement is true. Both members of Congress and officials of executive departments are in Washington to serve the best interests of the people as a whole. Their purpose is to do equity and justice. Therefore, in order to enlist their sympathetic attention to problems that arise it is only necessary to prove what are the facts and conditions and to show that the relief sought on the basis of those facts and conditions is well founded and just.

Political pressure and expediency will not accomplish permanent results, and never will be as effective as a clear presentation and analysis of facts, in matters of legislation. Everything that has been done in Washington for the mining industry bears out this observation. The same may be said for the agricultural and other industries. Those industries that keep out of politics and rely upon the merits of their case to carry them through successfully on the measures they sponsor stand high in the estimation of Congress and the executive departments of the Government.

The mining industry has made its case repeatedly on many issues during the last decade—mine depletion, war minerals relief, silver relief, mineral tariffs, war amortization allowances, repeal of the capital stock tax, discovery value, silver and copper revaluations for taxation purposes, noninterference of the Federal Government in the coal strike, and numerous matters of importance to the industry. Successful representation of an industry in Washington can be assured only as long as that industry's representatives keep their work on a broad, high plane, and maintain an unimpeachable record for honesty and accuracy in assembling and analyzing the facts that are called for by different branches of the Government before Government action can be secured.

A DANGEROUS EXPERIMENT

WITHIN the month the coal commission appointed by the British Crown has made its report and recommendations. The major features of this report are so closely akin to the recommendations of the United States coal commission as to be startling.

When the report of our own coal commission thus assumes international importance, it is worth while to consider anew the respects in which our own document proved rather dangerous. One recommendation which stands out boldly in both reports is that we consolidate many mining companies into a few and that we encourage the consolidations to abandon—or keep in suspense—the so-called "unnecessary" mines. When it is urged that we have too many mines, and when the desire is expressed that we get rid of those which are not needed, the method proposed seems to have merit. The older method of purging a glutted market was to allow the owners of those unneeded mines to sink into bankruptcy and the mine to fade out of the picture. In that case the loss is localized to the owner and to the community in which the deficient mine is situated. The alternative plan now brought forward is to take the deficient mine off the hands of the owner and to absorb it into a consolidation which can afford to close it because the cost of so doing can be spread over the whole production of coal and collected from the whole people. The latter would seem to be the proper thing to do—if it were not for the fact that we would have to suspend a full one-third of the existing mines.

Also, under our laws anyone who owns coal-bearing land has a perfect and inalienable right to work it—to produce the coal which it contains. To close one group of mines, therefore, but issues an invitaton to others to open more mines to take the place of those which have disappeared. This will surely be the case if the selling price of the coal is raised to a point where existing mines are collecting their own costs and a profit, plus the cost of carrying dead mines on their balance sheets. The coal industry has tried that experiment on a small scale. It did not work out. There is no reason to believe that it will work out if tried on a grand scale.

Another recommendation which appears in both reports is that the industry undertake cooperative selling. This is a new and interesting theory but it has never been subjected to a sufficiently thorough test to prove that it has any business merit. That is, if you grant to one group of men the right to sell cooperatively you automatically extend to another group of men the right to buy cooperatively. If the right to cooperate is not equal on both sides of a commercial transaction you have enacted class legislation.

This raises a tremendous thought which will require careful attention. For instance, if the coal operators

should be encouraged to sell their coal cooperatively, the people of a community—householders—would be encouraged to buy cooperatively. That, in short order, would destroy the distribution system in this country which has been built up through a century and upon which the people of this nation are forced to depend for the service of storage and delivery.

Also, if you encourage the operators of a district to unite to sell cooperatively, you encourage, for example, the railroads of the nation to buy cooperatively. In that sort of an arrangement, the operators grouped in district organization would be combatting the railroads organized on a national basis. The resulting lodgement of the balance of power with the buyer might result in the very destruction of the coal business which the whole scheme was designed to prevent.

Many of the other theories of the two reports are equally unproved and are equally open to serious question. If these theories are sound they can be worked out in a much smaller laboratory than the international coal industry. It would seem that they should not be tried out in such a large theater until they have, first, been put to the test in a much smaller field. This country is big and diverse enough to find one field where such a sweeping idea can be tested out without placing the whole international industry in danger by enticing it into an untried experiment.

INTERNAL-REVENUE COLLECTIONS

REPORTS on the internal-revenue collections for the first quarter under the revenue act of 1926 are very gratifying. They indicate that the new law will produce many more millions of dollars in taxes than either the Treasury Department or Congress anticipated. They show that the country is enjoying a period of great prosperity, and prove that further reductions in Federal taxes are possible.

This JOURNAL predicted some time ago that there would be sufficient revenue without the capital stock tax, without the stamp tax, and without the 1 percent increase in the corporation income tax rate. In fact, it was predicted that, notwithstanding reductions in normal and surtax rates on individuals, increases in exemptions, and repeal of the capital stock tax, the corporation rate could be reduced to 10 percent. We still hold this view; and, of course, if revenue collections for the year average up with collections for the first quarter, Congress should not hesitate to make further slashes in the tax burden wherever the result will be to further stimulate business and encourage the development of new enterprises. Reduction of the corporation rate to 10 percent and elimination of the stamp tax, which is a hang over from the war, will further stimulate business and should be considered first in the next tax revision bill.

The present tax law is so framed that there is little or no Federal tax burden upon agriculture, upon labor, or upon salaried persons. The tax burden is borne chiefly by the industrial enterprises of the country which popularly are referred to as "big business." In other words, "big business" pays the major portion of the Federal tax bill. And if the Government is able to collect this year more than enough revenue for its needs at the present rate of tax there will be ample justification for reduction of the corporation rate and the elimination of the stamp tax, measures that we contended should have been approved by this Congress in the present law.

THE POTASH BILL

THE Sheppard bill would give to the United States Geological Survey and the Bureau of Soils the sum of $550,000 annually for five years, to be used in an investigation of the possibilities and extent of our potash resources.

It is time that some such measure giving Government aid to this essential industry was enacted. We agree with the provisions of the bill in so far as it relates to an investigation of our potash deposits. But is the Survey the proper channel through which the work should be conducted?

Under its organic law the Geological Survey should study the distribution, structure, age, and mineral composition of rocks. As soon as mining, either by drill holes or shafts, or the extraction of ore from the rock is begun, the work is the immediate province of the United States Bureau of Mines.

While the Survey unquestionably has men on its staff competent to carry on the investigation, that particular work is distinctly a function of the Bureau of Mines, which is already fully equipped to carry on the investigation. If the Survey is made responsible, it will be necessary to use a considerable amount of the $550,000 in developing an organization which, after it is perfected, will be merely a duplicate of one already in existence. The Bureau of Mines was transferred from the Interior Department to the Commerce Department in an effort to simplify and coordinate the duties of the various agencies looking after mining affairs. That provision of the Sheppard bill which specifies the Survey as the agency through which this investigation should be conducted defeats the effort to centralize and coordinate the activities of government.

The important thing, of course, is that the bill shall be enacted, and that the potash deposits of this country shall be developed, in order that we shall not be at the mercy of a foreign country for this vital necessity. Government agencies report that potash minerals in large quantity, but not available for use under known processes of extraction, are found from New Jersey to Virginia; in Wyoming and Utah; in the Cripple Creek mine dumps; in Georgia, Minnesota and Illinois, and at Searles Lake, California. Possibly great deposits of soluble potash minerals (and if soluble, then easily available for use) exist in Texas, in the huge salt beds which extend from southeastern New Mexico and southwestern Texas, 650 miles northeast, through Oklahoma and Kansas. We should know how much potash is there. If in the quantity that seems possible it should be developed. We cannot know without extensive and expensive exploration which can be carried on only with Government assistance in some form.

At the present time the United States is almost wholly at the mercy of foreign producers. Germany and France have combined in control of the present supply, and Germany controls the deposits now being developed in Spain. We are almost entirely dependent upon European deposits for our supply of potash, and with our own resources unexplored and undeveloped will have to pay any price that the German-French syndicate may see fit to charge. There is no indication that it wishes to take advantage of our situation, but the development of a potash industry in this country will assure to our industries this product at a reasonable price for many years to come.

THE REVENUE ACT OF 1926

New Provisions Of Law Relating To Interest, Statute Of Limitations, Affiliated Corporations, And Government Claims Against Transferred Assets Of Corporations, Affect Many Mining Cases —New Regulations Expected May 1

THE Revenue act of 1926 contains a number of provisions, other than those relating to depletion, that are of more or less importance to taxpayers engaged in the mining industry. It is well not to overlook these changes in the law until action by the Bureau of Internal Revenue shall have been taken. A brief review of such provisions for the benefit of those who may be affected is therefore given.

The interest provisions are of considerable importance because they affect thousands of cases that are still pending from prior years. The same may be said as to the section relating to interest on refunds or credits.

Interest on Deficiencies

The law provides (Section 274 j) that interest upon the amount determined as a deficiency shall be assessed at the same time as the deficiency shall be paid upon notice and demand from the collector, and shall be collected as a part of the tax at the rate of six per centum per annum from the date prescribed for the payment of the tax (or, if the tax is paid in installments, from the date prescribed for the payment of the first installment) to the date of deficiency is assessed, or, in the case of a waiver by the taxpayer, to the 30th day after the filing of such waiver or to the date the deficiency is assessed whichever is earlier.

It is explained in the report of Senator Smoot, chairman of the Committee on Finance that the 6 percent interest upon a deficiency which runs up to the date of assessment began to run under the 1924 law on March 15 if the taxpayer had paid his tax in full; but if the tax was paid in installments, interest on one-fourth of the deficiency began to run on March 15, one-fourth on June 15, one-fourth on September 15, and one-fourth on December 15.

The new law requires that in all cases interest shall be computed from the date of the first installment, whether on that date one installment is paid or the entire tax. This change was made, according to Senator Smoot's report, to remove an apparent discrimination between taxpayers based on the manner in which they elect to pay their tax, and to eliminate an unnecessary burden on the collector's offices in figuring out the interest.

It is provided in Section 283(h) that in cases where the assessment was made before June 2, 1924, the interest shall begin to run from the date of the enactment of the 1926 act and continue up to the date of notice and demand from the collector. In certain of these cases, however, where notice and demand was made at the time of assessment, interest has been running since and Section 283(h) therefore provides that in such cases the 6 percent interest shall not be collected.

Interest on Refunds and Credits

Under prior law in the case of the credit taken against an additional assessment, the taxpayer was allowed interest from the date of his overpayment to the date of the additional assessment. In the case of taxes imposed by acts prior to the act of 1921, the taxpayer (except as provided in Section 283 of the 1926 act) pays no interest in the case of underpayment up to the date of assessment. Consequently, according to the report of the Conference Committee, it frequently happened that the taxpayer who owes the Government money upon which he is paying no interest is collecting interest upon money which the Government owes him.

The new law meets this situation by allowing interest in the case of a credit under an act prior to the revenue act of 1921 only to the date on which the original tax against which the credit is taken is due. In the case of refunds, interest has been allowed "to the date of the allowance of the refund." It has been the practice for the commissioner to sign the schedule of overassessment, which is then sent to the collector whose duty it has been to determine whether the overassessment should be credited or refunded, and interest has been computed to the date when the collector actually makes the refund or the credit. The new law fixes as the date upon which the refund is allowed the date on which the commissioner signs the schedule of overassessment.

Statute of Limitations

A new provision of considerable importance appears in the 1926 act relating to the bar of the statute of limitations. This is subdivision (a) of section 1106 and provides that the bar of the statute of limitations against the United States and against the taxpayer in respect of any internal revenue tax shall not only operate to bar the remedy but shall extinguish the liability. This provision will operate to prevent the income tax unit or any other branch of the department from holding up a settlement favorable to the taxpayer for one year merely because a review of the settlement made in a previous year indicates that the taxpayer owes some additional tax that the Treasury is barred from collecting because the statute of limitations has run against the assessment. It will also operate to prevent the Comptroller General from holding up payment on the refund in order to force the taxpayer to waive the limitation against an additional assessment for the prior year.

The statute continues the provision for an agreement, in writing, between the taxpayer and commissioner, which shall be final and conclusive, except upon a showing of fraud, malfeasance, or misrepresentation of fact materially affecting the determination or assessment thus agreed upon.

It is further provided in section 1109 (a) that notwithstanding any other provision of law, all internal-revenue taxes shall (except as provided in paragraph (2) or (3) of this subdivision) be assessed within four years after such taxes became due, and no proceeding in court without assessment for the collection of such taxes shall be begun after the expiration of five years after such taxes became due. In the case of a false or fraudulent return, failure to file a return or of a willful attempt in any manner to defeat or evade tax, the tax may be assessed or a proceeding in court may be begun, without assessment, at any time.

Section 1105 provides that no taxpayer shall be subjected to unnecessary examinations or investigations, and only one inspection of the taxpayer's books of accounts shall be made for each taxable year unless the taxpayer requests otherwise or unless the commissioner, after investigation, notifies the taxpayer in writing that an additional inspection is necessary. The 1926 law reenacts the provision in section 1107 which provides that in the absence of fraud or mathematical calculation the findings of facts in and the decision of the commissioner upon the merits of any claim presented under or authorized by the internal-revenue laws shall not be subject to review by any other administrative or accounting officer, employe, or agent of the United States. The only exception to this will be found in Title IX of the Revenue Act of 1924.

Affiliated Corporations

The law provides (section 240 (c)) that two or (*Continued on page* 242)

Hugh Shirkie, Shirkie Coal Company, Terre Haute, Ind. Mr. Shirkie was elected President of the American Mining Congress to succeed the late Colonel Daniel B. Wentz

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(*Continued from page* 240)

more domestic corporations shall be deemed to be affiliated, (1) if one corporation owns at least 95 percent of the voting stock of the other or others, or (2) if at least 95 percent of the voting stock of two or more corporations is owned by the same interests. This paragraph shall be applicable to determination of affiliation for the taxable year 1925.

It is further provided that two or more domestic corporations shall be deemed to be affiliated (1) if one corporation owns at least 95 percent of the stock of the other or others, or (2) if at least 95 percent of the stock of two or more corporations is owned by the same interests. As used in this paragraph, the law provides that the term "stock" does not include non-voting stock which is limited and preferred as to dividends, and that this provision shall be applicable to the determination of affiliation for the taxable year 1926, and each taxable year thereafter.

Claims Against Transferred Assets

This provision (section 280) was written into the law to meet a number of situations in which the assets of the taxpayer have, subsequent to the accrual of his tax liability, been disposed of in whole or in part, with the result that the Government can not successfully distrain or otherwise collect the full amount of the tax due. The following examples are given in the report of Senator Smoot for the Committee on Finance:

"(1) Corporation A may distribute its assets to its stockholders and thereupon either dissolve or continue undissolved.

"(2) Corporation A may sell its assets to Corporation B for a fair consideration either in cash or property or in stock to B. The proceeds are transmitted directly by Corporation B to the shareholders of Corporation A or indirectly to them through Corporation A. Corporation A thereupon either dissolves or continues undissolved.

"(3) Corporation A may reorganize into a partnership.

"(4) Corporation A may reorganize into Corporation B by a mere change of name or state of incorporation or by an amendment of the financial provisions of its charter.

"(5) Corporation A may impair its capital, but have what are in effect distributed assets in the form of unpaid subscriptions of its shareholders.

"(6) A husband may make a gift of the whole or part of his property to his wife.

"(7) Personal property of a decedent may be transferred to the beneficiaries without prior settlement of taxes accruing during the life of the decedent.

"(8) A decedent's estate with a claim for unpaid taxes accruing during the life of the decedent may be composed of real estate and pass directly by descent to the heirs.

"In all the above cases the transferee is not liable for the tax of the transferor, but is by reason of the receipt of the assets subject to an independent liability in his own person and payable out of his own estate, arising under the trust fund doctrine or some similar theory.

"Again, an independent liability may arise in respect of a person other than the taxpayer by reason of failure to pay from the taxpayer's estate the tax due from the taxpayer. * * * The liability which arises in the transferee in respect of the receipt of the assets is normally to be measured by the liability of the transferor at the time of the transfer. This would include the amount of the tax due plus all interest, additional amounts, and the additions to the tax provided by law, up to the time of such transfer.

"The section, however, provides that the liability of the transferee in this amount shall not in turn be subject to interest, additional amounts, or additions to tax, save that in case the transferee petitions the Board (meaning the Board of Tax Appeals) for a redetermination of his liability, the amount so determined shall draw interest at the rate of 1 percent a month commencing with notice and demand for payment following the final decision of the Board."

Other sections of the law will be reviewed in later issues. The regulations under the new act are now being drafted. The date of their publication has not been announced, but they may be expected about May 1.

The Joint Committee on Taxation to study the system under which the revenue laws are administered has not been organized. Meetings of the Ways and Means and Finance Committees will have to be called for this purpose. This committee doubtless will first make an exhaustive survey of the administrative organization of the Internal Revenue Bureau, and examine its procedure to determine to what extent further improvements can be made beyond those recommended by the Tax Simplification Board which ceased to exist in 1924.

S. Pemberton Hutchinson, recently elected Director, the American Mining Congress, to fill vacancy caused by the death of Col. D. B. Wentz

ITALIAN DEBT SETTLEMENT AND COPPER

Senator Ashurst, of Arizona, recently presented to the Senate a number of telegrams from mining and other interests in Arizona urging ratification of the Italian debt settlement plan because of its prospective benefit to the copper mining interests of that state. The telegrams pointed out that Italy purchases large quantities of copper from the United States and that approval of the debt settlement plan will improve Italy's economic situation and buying power and produce favorable conditions for the exportation of copper from the United States to that country. It was said that Italy imports annually three hundred million pounds of copper and that the American copper industry needs this trade as it is just emerging from a five-year depression; that Italy has taken half of Arizona's copper production and that the state will face a serious economic problem if the debt settlement plan is not approved. "If copper mining is curtailed as a result of non-approval of the settlement, Arizona will suffer," said one of the petitions. It was also pointed out that copper exports for the last half of 1925 were only three-fourths of those during the first half of the year.

A BALANCED PROGRAM FOR COAL

A Needed Reform In One Direction Must Not Create A New Problem In Another—New Sales Policies And Mechanization Of Mines Are Increasing The Proportion Of Slack And Making The Disposal Of Slack A Real Problem For The Industry

By GEORGE H. CUSHING

THE doctors are specializing on a balanced ration for the human body. Political economists are directing their attention to a balanced budget for governments. It seems to be in fashion, therefore, to discuss a balanced program for the coal industry. But when we venture into that subject the main and proper idea to keep in mind is that a desired or necessary reform in one direction shall not be allowed to create a serious problem in another direction. Almost every reform that has been attempted or suggested in coal has proved to be a case where the cure was worse than the disease.

A few practical experiences of the coal industry, even in recent months, will prove the need for a balanced program. It is readily recalled that, only a short time ago, the people of New England were being advised to use substitutes for anthracite. Those who produced the substitutes wanted, of course, to make the sales at once. And having a favorable introduction, they wanted and hoped to retain a portion of the market for themselves. The whole situation, therefore, seemed to invite a plunging campaign. At this point some gentlemen who have charge of the sales of the substitutes advised the operators to go into an advertising campaign throughout New England. They wanted to use this plan to sell the substitutes for anthracite. On its face, it looked like a good thing to do. However, a little closer study and a little deliberate thought proved quickly that it was rather a venturesome undertaking. That is, New England has used the prepared anthracite coal, namely, sizes larger than pea coal. If they should buy any other kind of coal they would want it prepared in their familiar sizes. The proposed advertising campaign on bituminous, therefore, was to sell the prepared sizes of that coal. Of course, that could be done. But after the coal had been sold it would have to be delivered. That meant that the prepared coal would have to be produced. However, in order to get, let's say, 60 or 50 percent of prepared coal the operators would have to produce 40 or 50 percent of slack. They could sell the prepared coal by an advertising campaign. But they couldn't sell the resulting slack at all. The slack, therefore, either had to be thrown away or dumped on the market to break the price of all the slack now being produced. To do the latter, the operators might, possibly, break the price of even the mine-run coal. As the problem was thus worked out in actual dollars and cents, it was proved that these operators could not afford to advertise the prepared coal and then accept the resultant loss on the slack. In that instance there was no way of balancing the program; therefore the safe thing to do was to abandon the advertising program, and that is what happened.

Only recently another question has been raised. The operators know thoroughly, and have known for years, that it is perfectly silly to install machinery that will cut coal out of the vein and to supply themselves with a complete underground railway with fast-moving trains to haul the coal away, and then to slow the whole operation down by having men with hand shovel laboriously and slowly take the coal off the floor and put it in the pit car. This is a matter of spending money to get speed and then of killing that speed by clinging to the old hand-shovel method, which destroys any possibility of speed. The operators, therefore, have been working around toward mechanical loading. A little belated, but nevertheless opportunely, they are now studying the question of mechanical loaders.

In actual practice this raises three pretty serious questions. The first one can be passed over quickly, because it is being disposed of. That is, if you are going to load coal rapidly you lose all the advantage of the loading machinery unless the gathering motors take the loaded cars away and place the empties just as quickly as the expensive machine can load them. That involves an entirely new problem in underground transportation, particularly in the stub entries and inside the rooms.

However, one serious question which has come up is: How is the coal going to be cleaned below ground? A mechanical loader is an impartial force. It will scoop slate and rock into a car just as readily as it will coal. It has no discrimination. Once that conglomerate is loaded into a pit car, the miner is paid for producing it. If the loader puts slate and rock into the car, the miner gets paid for producing that slate and rock. Also, after it gets to the tipple it is necessary to have a complete cleaning system, especially with respect to the fine coal. The problem at the minute is: The operators can save money by loading with machinery, but he loses an undertermined amount; first, by paying the miner for producing the impurities, and, second, by the cost of removing those impurities from the coal on the tipple.

A second problem, also, injects itself at this point. Bituminous coal is a friable substance; the more you handle it the more it breaks. It breaks up the coal to take it down out of the vein. It breaks the coal further to load it by machinery. It breaks the coal still further to put it through the preparation plants which, either automatically or by hand, extract the dirt from the coal. And, with every breakage, there is an increase in the production of slack which, for the moment, is not salable at a profitable price.

Getting off into quite a different phase of the coal question, there is, these days, a lot of talk about cooperation. In every direction there are being organized rather elaborate cooperative movements As these things are organized, various groups are being invited in to help solve some of the coal problems. On its face, the proposal to cooperate generally seems appealing. On theory, the more people there are working on the coal problem, the more there will be to sympathize with the operator and to understand his difficulties. On its face, the cooperative movement looks good.

However, one of the most insistent suggestions that has been made touching cooperation has to do with the organized creation of storage piles. It is possible to work out a theory touching storage which is letter perfect. That theory is that if you could get storage piles properly placed and the ambitions of various people synchronized, the mines could produce steadily and, hence, get a low cost of production. Also, the coal that was not moving directly into use would move into storage. By the latter process there would never be any shortage of coal and, therefore, there would never be any wild fluctuations in prices and, consequently, no public dissatisfaction with the coal business. Cooperation to get storage piles is one of the most poetic of the various dreams that have been developed in connection with the future of coal.

There happens to be a fly in that ointment, also. The practical experience of the coal industry is that when coal is flowing into storage there is being produced more than is being consumed. Therefore, at such times the market price is very low; certainly not profitable. It may result in (*Continued on page* 247)

SOUTHERN INDUSTRIAL DEVELOPMENT CONFERENCE

Meeting Held Under Auspices Southern Division American Mining Congress At Memphis, Tennessee, An Earnest Attempt By Southern Industrial Leaders To Work Out Ways And Means Of Developing Southern Mineral Resources—C. J. Griffith Elected Chairman Southern Division

THE Southern Industrial Development Conference held under the auspices of The Southern Division of the American Mining Congress, at Memphis, Tenn., March 15, 16 and 17, marks a great stride forward in the industrial development of a territory that is so richly blest by nature that it could make itself entirely independent of the world, for besides its great agricultural capacity, the 13 southern states contain in commercial quantities some 83 minerals, all in high-grade quality.

The program was a highly constructive one. While it emphasized mineral possibilities, its scope covered many economic phases of industry that must be considered in the development of any new industry. Approximately two hundred mining men, industrial leaders, engineers, railroad executives, and manufacturers were in attendance. The sessions were marked by earnest, sincere effort to arrive at some basis upon which the great industries of the south may come into their heritage.

The first session opened in the Peabody Hotel, on Monday morning, March 15. C. J. Griffith, member of the Board of Governors of the Southern Division, presiding. After the addresses of welcome by the Mayor of Memphis, and others, the entire session was given over to a roll call of southern industry. Each of the 13 states presented its case. And any jury after listening to the testimony of these business men, must return a very satisfactory verdict for the South. The evidence was conclusive, comprehensive and sustained by indisputable facts and statistics. The South unquestionably is on the threshold of a great industrial expansion and it is evident that the delegates to this convention are going to see her safely over that threshold, well on the road that will lead directly to her industrial independence. Instead of producing her raw materials and sending them out of the territory to be manufactured into finished products, the South proposes to establish her own manufacturing industries; in fact already has taken steps in that direction.

The second session was devoted to a discussion of what the protective tariff means to the South. A letter was read from Richard H. Edmonds, editor, Manufacturers Record, in which he urged the South to forsake politics where the tariff is concerned. He stated further:

"No other section of the country needs the benefit of a protective tariff as much as does the South. It is entering upon a mineral and industrial development which is in its infancy. . . . The tariff question should be considered absolutely from the economic standpoint; hundreds of thousands of southern people believe in a protective tariff, but because of political affiliations have not made an open fight to demand it."

Herbert Wilson Smith, of the Union Carbide Co., of New York, and for six years head of the Tariff Division of The American Mining Congress explained to the conference the principles upon which the tariff work of that organization was carried on. He pointed out the fallacy of producing in a protected market and selling in a free one; he stated that the very people who would greatly benefit by protection were often the hardest to convince of its assistance. He urged the South to consider the tariff only in its economic possibilities, because it is a question that has no place in politics.

The full proceedings of the Southern Industrial Conference, held at Memphis, Tenn., March 15, 16, 17, will be printed as a separate pamphlet and copies may be obtained at $2 per copy upon request to the American Mining Congress, 841 Munsey Building., Washington, D. C.

Dr. Henry Mace Payne made an interesting and instructive address on "Points of Contact Between Capital and Resources."

"Power in Industry" was another topic to which considerable discussion was given. The first address upon this subject was made by B. E. Eaton, president of the Mississippi Power Co. In part Mr. Eaton said:

"Industry involves a great many elements; raw materials, labor, initiative, enterprise, confidence, a safe state and national policy, reasonable protection of the laws, and power." After discussing the growth of power through the development of hydroelectrical power, Mr. Eaton said, "We are steadily approaching the time when the steam engine will be discarded, because it will be demonstrated that electrical power can be furnished more cheaply than steam power. Hydro-electrical power will be so much more cheaply produced that it will entirely supplant steam power." He pointed out that 75 percent of the coal companies of Alabama do not use their own coal to create power for their mining purposes. They use electrical power.

M. H. Aylesworth, managing director, The National Electric Light Association, who addressed the meeting upon the subject of "Power in Industry," said:

"Today in the United States the American working man has an average of four horsepower at his elbow, and this is the answer to those of foreign countries who wonder at our industrial progress. . . . Since 66 percent of our total electrical supply comes from fuels, economy in fuel utilization is all important. The consumption of coal or its equivalent by electrical plants has been decreased from 3.2 pounds per kilowatt hour as the average required in 1919 to 2.1 pounds in 1925. While the uninterrupted supply of low-cost electric energy in the face of repeated increases in the costs of land, of labor, of materials, of fuels, and of taxes, has been an important factor in the maintenance of America's industrial prosperity, its continued availability has been made possible only by the most economical use of the country's natural resources. . . . If the United States has contributed anything at all to the industrial world, it is this: Do not aim at reduced wages and longer hours for workingmen in order to sell goods more cheaply; but strive for higher wages and shorter hours which can be brought about by improved industrial methods, standardization, mass production, the saving of waste and better coordination in the application of electricity." Mr. Aylesworth spoke against Government operation of the power industry; he cited instances of gross incompetence wherever the Government had attempted to compete with private operation of industry. In this connection he pointed out that, "Government ownership enterprises began at as early a date as corporate enterprises; that the development of Government ownership enterprises has been quite insignificant as compared with the development and growth of corporate utility enterprises during the same period, and that if we put our entire dependence from the beginning upon the Government ownership theory, electric service today would be of insignificant proportions."

Another subject that received consideration at the hands of the convention was "Public versus Private Operation of Industry." J. W. Cowper, engineer and past president of the Associated General Contractors of America, made a strong plea in behalf of keeping Government out of the contracting industry and urged the convention to cooperate with the movement recently organized at Washington known as the Government in Industry movement. Mr. Cowper cited numerous incidents where Government and private industry had bid on various enterprises and in each instance the private corporation bid has been substantially beneath that of the Government both as to the length of time required to complete the job and in the actual cost. Mr. Cowper urged the taking of Government out of business and cited as instances the Post Office Department, through its activities in competition with the printing industry, the building of battle ships and other shipping equipment and in the river and harbors activities of the engineers' corps. In conclusion Mr. Cowper stated, "the tendency of our governments, municipal, state and Federal, to continually expand themselves and increasingly absorb the functions of private enterprise is a danger to our industrial fabric and our social structure. We can perform no higher duty than to preserve private initiative, one of the sacred rights of our people upon which the integrity and prosperity of American business rests and the principal upon which our great American Government is founded."

C. J. Griffith, Chairman, Southern Division, The American Mining Congress

Dr. Frank L. Hess, chief mineral technologist of the U. S. Bureau of Mines, delivered an interesting paper on the South and Texas Potash, whieh paper appears in full in this issue.

At the banquet held on Tuesday evening, the principal speakers were Mr. L. Warrington Baldwin, president of the Missouri Pacific Railroad, who discussed the "Importance of the Railroads to the Mining Industry," and Hon. H. W. Seaman, a member of the Advisory Board, Inland Waterways Corporation of the U. S., on "Waterways and the Industrial Skyland." Herbert Wilson Smith, Union Carbide Co., New York, presided as toastmaster.

Financing industrial development was discussed by Dr. Walter Lichtenstein, executive secretary, First National Bank, Chicago, and the severance tax was discussed by the Hon. George Vaughan, president of the National Tax Association.

The Convention appointed a Ways and Means Committee to work out a permanent southern organization which shall have for its major purpose the development of southern industry. This committee is composed of the following representatives: J. H. Hand, chairman; L. J. Folse, representing Mississippi; I. B. Tigrett, representing Tennessee; Frank G. Louthan, representing Virginia; S. J. Ballinger, representing Texas; C. Arthur Bruce, representing Chamber of Commerce, Memphis; V. M. Montgomery, representing South Carolina; I. N. Day, representing Kentucky; J. L. Woodcox, representing North Carolina; C. G. Memminger, representing Florida; J. L. Davidson, representing Alabama; I. B. Rennyson, representing Louisiana; B. Mifflin Hood, representing Georgia; Chas. E. Sandberg, representing West Virginia; A. B. Livingstone, representing Oklahoma, and J. H. Hand, representing Arkansas.

The following gentlemen were elected to the Board of Governors of the Southern Division, The American Mining Congress: C. J. Griffith, Little Rock, Ark., chairman; J. G. Bradley, Dundon, W. Va.; Chas. W. Johnston, Norfolk, Va.; Dr. A. F. Greaves-Walker, Raleigh, N. C.; E. L. Hertzog, Spartanburg, S. C.; J. N. Mallory, Savannah, Ga.; C. G. Memminger, Asheville, N. C., representing Florida; Jas. L. Davidson, Birmingham, Ala.; W. H. Smith, Laurel, Miss.; I. N. Day, Dawson Springs, Ky.; Howard I. Young, Mascot, Tenn.; H. B. Flowers, New Orleans, La.; C. J. Griffith, Little Rock, Ark.; S. J. Ballinger, San Antonio, Tex.; Prof. E. E. Tourtelette, Wilburton, Okla.

At the conclusion of the morning session on Wednesday, March 17, a demonstration was made of a natural refractory material mined in eastern Tennessee and commercially known as American "baukite." This was used as a bond or mortar between two high grade number one firebrick and showed that the bond withstood a temperature of 5,600° F., under 40 pounds pressure, one-half inch radius, for ten minutes without decrepitation. The purpose of this was to indicate that there is a natural refractory material suitable for laying up fire brick as well as for manufacturing of fire brick superior to any now on the market.

The following resolutions were passed and approved by the convention:

RESOLUTION No. 1

WHEREAS potash is one of the vital necessities for agriculture and, consequently, for the life of the United States; and

WHEREAS the United States at the present time is almost wholly dependent upon foreign sources for its supply of potash; and

WHEREAS it appears that the United States may with proper research develop ample supplies of potash for its present and future needs from either or both soluble or insoluble potash minerals; and

WHEREAS the Congress of the United States has organized the United States Geological Survey to investigate the minerals of the country as they are in the ground, and has created the Bureau of Mines to investigate the mining and technology of minerals; and

WHEREAS Senator Sheppard and Representative Hudspeth have introduced bills in their respective branches of the Congress of the United States providing for explorations for and research on potash minerals by Government agencies: Therefore be it

Resolved, That the Southern Division of the American Mining Congress approves the principle of these bills and urges as a national need that one or the other of the bills should be passed, but; be it further

Resolved, That the bills be so amended that sites for drilling or shaft sinking for potash minerals be selected by the United States Geological Survey, but all drilling shaft sinking extractions of minerals and technology of minerals shall be conducted by the Bureau of Mines, of the Department of Commerce.

RESOLUTION No. 2

WHEREAS Mr. Richard H. Edmonds, through his great and inspiring publication, *The Manufacturers Record*, and by his personal effort in various ways, has for over 40 years appealed to the South to take advantage of its unsurpassed resources; and

WHEREAS as a result of the untiring and unrelentness efforts of this great and invaluable citizen the South is gradually responding to his appeal; and

WHEREAS every southerner is deeply appreciative of all Mr. Edmonds has done: Therefore be it

Resolved, By this conference that we do feel that Richard H. Edmonds has by his unselfish work for the South earned our everlasting love and gratitude; and be it further

Resolved, That a copy of this resolution be sent to Mr. Edmonds, and given to the press.

RESOLUTION No. 3

WHEREAS the Southern Division of the American Mining Congress has deemed it fitting and advantageous in furtherance of the development of the South to convene at this time for the purpose of an industrial conference; and

WHEREAS certain measures pertaining to the industrial development of the southern United States have been fully and intelligently discussed; and

WHEREAS it being definitely and fully realized that development in any sense is largely, if not wholly, dependent upon the well-being of the citizens and the environment and advantages which they have to offer; and

WHEREAS it being definitely and fully realized that the potential wealth of the states considered is so great as to be attractive to capital; and

WHEREAS knowing and realizing that the presence of malarial fever in the South has in the past served as a handicap to the South's contribution to industrial development in national progress, and knowing that steps of eradication are in progress and have shown that intensive work can entirely eradicate this handicap, commendation for the great work already done being herein expressed; and

WHEREAS knowing that its elimination will expedite the development of the national resources of the Southern States, basing this statement on results already accomplished in many sections; and

WHEREAS we being informed by an international authority on the subject, Mr. J. A. Le Prince, who as chief aid to the late Gen. William C. Gorgas, when yellow fever was eliminated from Havana and the Panama Canal Zone and malarial fever was adequately controlled in these parts of the world, and who is now in our midst, together with Mr. George Parker, who served with Gorgas and Le Prince in Panama and who has lately demonstrated in Yazoo County, Miss., that malaria need not stand in the way of development; and

WHEREAS these two sanitarians now present at this convention assure us that malaria can be practically eliminated at relatively low cost throughout the areas awaiting development: Therefore be it

Resolved, That we in convention assembled do hereby endorse a program that will lead to the complete elimination of a former handicap to development of the South, thereby giving full impetus to that great development which has been begun, and that this resolution be broadcast through the press and otherwise throughout the South, to the end that business men, especially, be impressed with the necessity for the complete eradication of malaria.

RESOLUTION No. 4

Be it Resolved, That the Southern Division of the American Mining Congress emphatically disapproves of the Government engaging in private business in competition with legitimate industry and individual endeavor, especially as regards construction, manufacturing, transportation, and printing.

RESOLUTION No. 5

Resolved, By the Southern Division of the American Mining Congress that in the making of any contract by the Federal Government for the operation of the development at Muscle Shoals that the factors involved should be considered in the following order of importance: First, national defense and security; second, the manufacture of fertilzer and its component parts; and, third, the distribution of surplus power in accordance with and in the manner provided by the resolution recently enacted by Congress.

RESOLUTION No. 6

Be it Resolved, By the Southern Division of the American Mining Congress in convention assembled that it express its deep appreciation to Dr. Henry Mace Payne for his work in behalf of southern mineral development and to the American Mining Congress for the unselfish service of its splendid organization towards the expansion of southern industry.

RESOLUTION No. 7

WHEREAS the Southern Division of the American Mining Congress is drawing to a close its industrial conference in Memphis; and

WHEREAS the mayor of Memphis, the Hon. Rowlette Paine, has by his opening address and continued presence at our meeting typified the hospitality and interest of that city; and

WHEREAS the Memphis Chamber of Commerce, representing the civic organizations, through their active participation and valued assistance have aided greatly in the furtherance of this conference; and

WHEREAS the newspapers and press of Memphis generally have placed at our disposal their facilities for acquainting the public with the activities of this conference; and

WHEREAS the Peabody Hotel has contributed greatly to our comfort, convenience, and pleasure; and

WHEREAS the Southern Railway, the G. M. & N. Rwy., and the Bureau of Mines of Arkansas by their splendid exhibits have given us a fuller appreciation of southern mineral resources: Therefore be it

Resolved, That the Southern Division of the American Mining Congress gives its hearty and unqualified thanks to these individually and as organizations for their aid in making possible this successful conference which it is our earnest belief will be invaluable to the industrial development of the entire South, and that a copy of this resolution be made a part of the records of this meeting.

RESOLUTION No. 8

(Introduced by L. J. Folse, J. H. Hand, Frank G. Louthan, Committee on Ways and Means.)

WHEREAS the American Mining Congress has during the past 30 years guided the development of the mining industry of the United States to a basis of industrial and commercial security; and

WHEREAS the mining industry produces 65 percent of the shipping of the United States; and

WHEREAS the sources of mineral production of the United States in the past have been chiefly in western and northern states; and

WHEREAS the American Mining Congress has during recent years expended a large sum of money in making a survey of mineral resources of Southern states without asking for or receiving local aid; and

WHEREAS the reports of these surveys are unpublished, and the Mining Congress is without funds necessary to have same printed; and

WHEREAS these investigations have disclosed that the 14 states embraced in the Southern Division of the American Mining Congress singularly and collectively possess immense mineral wealth yet undeveloped; and

WHEREAS the mineral resources of the South are unknown to the investment and mining world except in a general way; and

WHEREAS the publication of reports on the surveys would establish contact between the undeveloped mines in the South and the outside mine developers by affording a medium of satisfactory information; and

WHEREAS the American Mining Congress has reached the end of its field investigation and, therefore, the limit of its service to southern development until the data it has obtained can be given to the world; and

WHEREAS since the American Mining Congress has made the discovery of undeveloped resources in the South the people of these states wish to cooperate and assist in hastening their development through the making of the facts known to the world: Therefore be it

Resolved, By the Ways and Means Committee, composed of representatives from the several southern states, that the continued activity of the American Mining Congress in these states is essential to its mineral development; that we believe the people engaged in the various industrial and commercial pursuits that would benefit from mining industry desire to see such development stimulated and hastened; and that the people of these states will be glad to assist with their means in cooperating with the Mining Congress in its program for southern mineral development, which is estimated to cost $25,000 a year, including the publication of surveys made and other vital facts concerning the southern mining industry; be it further

Resolved, That the people of each state below named be and hereby are asked to aid in upbuilding this branch of its industry, to wit: Virginia, $1,500; West Virginia, $1,500; Kentucky, $1,500; Tennessee, $1,500; Arkansas, $4,000; Louisiana, $3,500; Texas, $4,000; North Carolina, $2,000; South Carolina, $500; Georgia, $1,250; Florida, $1,250; Alabama, $2,500; Mississippi, $1,500; Oklahoma, $1,500; be it further

Resolved, That the authorized representatives of the American Mining Congress undertake severally to have the people of their respective states contribute the sums of money designated above during the next 12 months for the use and purpose above stated; be it further

Resolved, That representatives of the American Mining Congress be authorized to solicit the support and cooperation of any and all lines of business within their respective states that may benefit from the development therein of the mining industry; be it further

Resolved, That the press within the states aforenamed be requested to give its support for this movement.

An interesting analysis of the mine tax laws of the western states has been issued by Robert I. Kerr, secretary of the California Metal and Mineral Producers Association.

BALANCED COAL PROGRAM

(*Continued from page* 243)

a price which nets a loss. The only way that any loss can be overcome or any profit made is to have another period in that year when more coal will be consumed than is being produced and when the prices rise as a result of competitive bidding. Of course, if you get the storage pile big enough, and if you get the storage program extensive enough, there will be long periods when the prices will be at or below the cost. And there never will be a period when prices will rise above cost. This will be so because if the price should tend in an upward direction the storage piles would be used. To arrange, therefore, for an elaborate storage program in coal is to arrange that present summer prices on coal shall prevail throughout the year.

Looking at this same storage question—one of the most interesting expressions of the cooperative movement—in another way: It is usually found that those who are the leaders of the storage movement are also the shrewdest buyers of coal. At times they even seem to have a kind of unit program touching their purchases. When they have built up their storage piles to a certain extent, and when the mines are moving them coal on open order, they suddenly retire from the market. This leaves the operators and sales agencies with quantities of unsold coal on hand, subject to both demurrage and reconsigning charges. In such a position, the coal industry finds itself at the mercy of these organized buyers.

These instances are recited to show how easy it is to do one thing that is desirable and even necessary and at the same time to create another problem which is worse than the one that the reformers were trying to run away from. Therefore, it is equally easy to see that the one thing which the coal industry must do promptly is to devote its attention to a balanced program where all of the complexities of the business are taken carefully into account. If the foregoing is studied critically, there will be found a way of getting at the root of the difficulties because, while they are imposing, they are not insuperable.

For example, New England and other parts of the country want prepared coal, temporarily, and that market will have to be satisfied. Also, arrangements must be made to take advantage of all the speed and all the low cost of production that can be contributed by mechanical loaders. Furthermore, both cleaning devices and storage programs are inevitable additions to the coal industry. They are coming, and there is no way to avoid them.

However, all of these things result in a steady increase in the percentage of slack coal that is produced. And in the price of slack today resides the embarrassment of the coal industry and the potent cause of financial loss to the trade. Therefore, the one thing that has to be done before the other four programs can safely be introduced is to find some new method of disposing of the slack coal. The one thing out of balance in the coal program is the slack situation. A balanced program in coal demands some solution of the slack problem. Until some way is found to dispose of the slack, every reform of the coal business but intensifies its grave problem, because all such reforms increase the percentage of slack.

EXPLOSION HAZARDS OF PULVERIZED COAL

An investigation of explosion hazards from the use of pulverized coal as a fuel at industrial plants has been made by the Bureau of Mines. When pulverized-coal fuel in the industrial plants of the United States caused fires and explosions that killed workers and damaged property, the Bureau availed itself of the opportunity to study the conditions under which such disasters occurred, and thereby collect information that would complement investigations of dust explosions in coal mines.

Since natural-gas production has declined near a number of the large industrial centers, especially those where the plants require a steadily intense heat in the manufacture of their product, pulverized coal has been largely adopted as a substitute. As an adequate supply of natural gas becomes more and more difficult to obtain, it is reasonable to expect that the use of pulverized coal will increase.

Pulverized coal is being introduced in the steel industry as a fuel for sheet furnaces, billet furnaces, and small forge furnaces; in cement mills for burning clinker; in large power plants for generating steam in the boilers; and in the large smelters, mostly reverberatory plants, in the West for the reduction of copper ore.

The principal constituents of coal that have a direct bearing on the explosibility of coal dust are moisture, volatile matter, fixed carbon, and ash. Fineness is the physical characteristic that governs the explosibility of pulverized coal. Pulverized coal in bulk is not explosive. It becomes dangerous only when stirred up into a cloud with the proper proportion of air and brought in contact with an open flame or a body having a temperature high enough to ignite it.

Detailed safety instructions are given in Bulletin 242, "Explosion Hazards from the Use of Pulverized Coal at Industrial Plants," by L. D. Tracy, coal mining engineer, copies of which may be obtained from the Bureau of Mines, Department of Commerce, Washington.

STANDARDIZING UNDERGROUND TRANSPORTATION

No Problem Connected With The Mining Industry Has Been Given Less Attention And Study Than Transportation—Efficient Standardization Includes Application To Mining Systems, Methods Of Loading And Gathering And Transportation From Face To Terminal

By M. E. HAWORTH *

THE subject of "Underground Transportation" has received much attention from many sources and much commendable work has been done toward placing this phase of mining on a modern basis. Progress has been slow, but methods are gradually changing, the last few years having seen great strides. Present costs demand attention to the equipment and methods involved in the production of coal, and progress is being made toward reducing the cost in cars at the tipple. Underground transportation is a link in the chain and must be given no less attention than other subjects of importance. Perhaps no other problems connecting with the mining industry have been given less attention and study than transportation problems, but in order to reduce costs to the ultimate minimum, this subject must be duly considered and economies effected.

One need only consider the subject briefly until he finds that it is broad in its scope, and involves not only theoretical and mathematical treatises, but hard experience which teaches how to apply it on a practical basis. Time and money are required for engineering, experimentation, and research work, but satisfactory returns will result if the work is carried on by those equipped with sound judgment tempered with the necessary experience.

Present-day operations make use of three distinct types of transportation systems, although combinations of all three are more often used: Rope haulage, locomotive haulage, and conveying systems.

Rope haulage, as a standard system, is gradually falling into disuse on account of its high cost and inflexibility, although still widely used where grades are unfavorable for locomotives. Electric locomotive haulage is widely used where grades do not persist above 5 to 6 percent on main lines, or above 6 to 8 percent on butt headings. This system has many advantages over other systems, both by reason of its economy and flexibility, and is the one system of transportation to which standardization can be profitably applied. Conveying systems are comparatively new and are finding a wide range of application, but for commercial mines where lump coal is the premium product, it is doubtful if these systems will ultimately prove as economical as first impressions might anticipate, except the so-called "face conveyors," which deliver coal from the face to mine cars located at a convenient point on the butt or face heading. Mining systems have been specially designed for use with conveying systems, and some measure of success has been met with. But where the adopted system differs radically from the system replaced, involving large initial investments, for equipment, delicately timed advance of face and rib sections, heavy timbering with little or no recovery, elaborate and costly cleaning equipment on the tipple, labor, and other difficulties, extreme precaution should be exercised before such systems are adopted. Rubber covered canvas belts have been used successfully for conveying large tonnages long distances, but these installations have usually been made to take advantage of very special conditions, and by no means represent a revolution in the underground transportation of coal as applied generally to all classes of mines. No doubt their use will find wider applications as experience finds their possibilities and limitations, but as a matter of economy, mine cars will continue to deliver coal from the "face" or near by for an indefinite length of time.

"Standardization" is a word which is widely used, although partially misunderstood; nevertheless, it has been profitably applied to many classes of industry. It does not necessarily specify fixed rules, methods, or equipment without a certain range of flexibility whereby growth and expansion are permitted in order that advantage may be taken of past experience and future developments. Standardization should be taken in its broader sense as endeavoring to secure the best results with minimum cost and effort. In this sense, it can profitably be applied to the underground transportation of coal.

A full treatise of the subject is necessarily far reaching and includes systems of mining and loading as well as transporting to the shaft bottom or tipple, but space here is too limited for detailed analyses of all the factors involved and generalties only will be considered; mathematical treatises, underlying theories, and fundamental principles being purposely avoided.

In order to apply the principles of standardization to this phase of the industry, the following principal features should be included: Mining systems, methods of loading and gathering, and transportation from the "face" to outby terminal. The full consideration of these features involves a consideration of the size and shape of mine cars, size and weight of gathering and main line locomotives, track and track equipment, ventilation, and power supply; all so designed and coordinated as to result in the maximum tonnage with the minimum investment in labor and equipment.

MINING SYSTEMS

The most widely used mining system in the United States is the face and butt room panel system, or modifications of of the same. Depending upon the character of the roof, overburden, and the recovery of ribs, this system is mined "full advance," "half advance and half retreat," or "full retreat," the latter undoubtedly being the most economical, considering both mining costs and the conservation of the natural resources. More recent modifications of this system which concentrate operations to minimum areas, considerably increasing the tonnage mined from a given section in a given period, produce several satisfactory results, viz, reduce the extent of territory in operation, permit ribs to be recovered before roof conditions begin to give serious trouble, reduce the quantity of water pumped and the area ventilated as well as the length of main line and gathering haulage. Where animals are used for gathering, the system must be so designed that the average and maximum lengths of haul on favorable grades do not exceed approximately 800 and 1,300 feet, respectively, which experience indicates are approaching the upper limits of travel for efficient animal performance. Where gathering locomotives are used, the lengths of haul may be increased by locating partings on face headings instead of on butt headings, but it is doubtful if the length of butts can be increased beyond the length of 1,500 to 1,600 feet without sacrificing either recovery or mining costs. Other systems, including the longwall, may be used with equal or better results, depending on local

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conditions, but so far as haulage is concerned, the best results demand concentration of the working areas. Systems of mining designed for use with conveying systems have met with more or less success, but being recent developments in mining, extensive experimentation is required before they can be demonstrated as being capable of as wide application as the room panel system to which face conveyors can be successfully applied in a large number of cases. In any event, the mine car and locomotive will continue to play an important part in the transportation of coal mined by these systems, the belt conveyor being the only possible substitute. But until the market—for commercial mines at least—changes its demand for lump coal, and until the coal industry is on a more stable basis where steady operation is assured, belt conveyors will offer little competition to the mine car and locomotive as a general proposition.

Loading and Gathering

Having the mining system laid out and having chosen the method of gathering, the location of partings or side tracks is the next step to be decided. This location will be either on the butt or face, depending on whether animals or locomotives are used, upon the pitch of the seam, and upon the tonnage to be handled. Where coal loading machines are used, larger tonnages will be loaded, necessitating a rearrangement of track work, but not necessarily any change in the design of track equipment and accessories. For the average seam containing impurities, coal loaded by machines requires more elaborate 'eaning equipment on the tipple than coal cleaned by the miner at the "face." Consequently, for the same quality product, mining costs of coal loaded by machines must be increased by the capital and labor charges covering cleaning on the tipple when compared with costs of hand loaded coal, although there will probably be other savings in favor of machine loaded coal which must be credited.

A side track of the desired capacity can be designed in the location indicated as being correct, although care must be exercised that ventilation is not seriously interfered with so as to require expensive overcasts and cumbersome trap doors on the haulage road. As a matter of safety, three tracks could be provided, or the equivalent; one track for the storage of empty car trips; one for the storage of loaded car trips; and one track always open to allow the locomotive to head empty trips into the empty storage track and pass through the open track to head the loaded trip to and along the main line.

Where conveying systems are used for gathering the coal from the "face," larger tonnages are produced from comparatively small sections, reducing the ton-miles of haulage. Some face conveyors deliver the coal to the outby end of the butt; others to the room neck only. Whatever the system of loading or gathering, the coal is eventually discharged into mine cars for delivery to the outby terminal, and the same general principles apply as to animal or locomotive gathering, requiring only a change in the detail of the track arrangement.

The design of the main line haulage, including track turnouts, passing side tracks and curves, should be such that heavy trains can be moved at full speed between terminals without the neces-

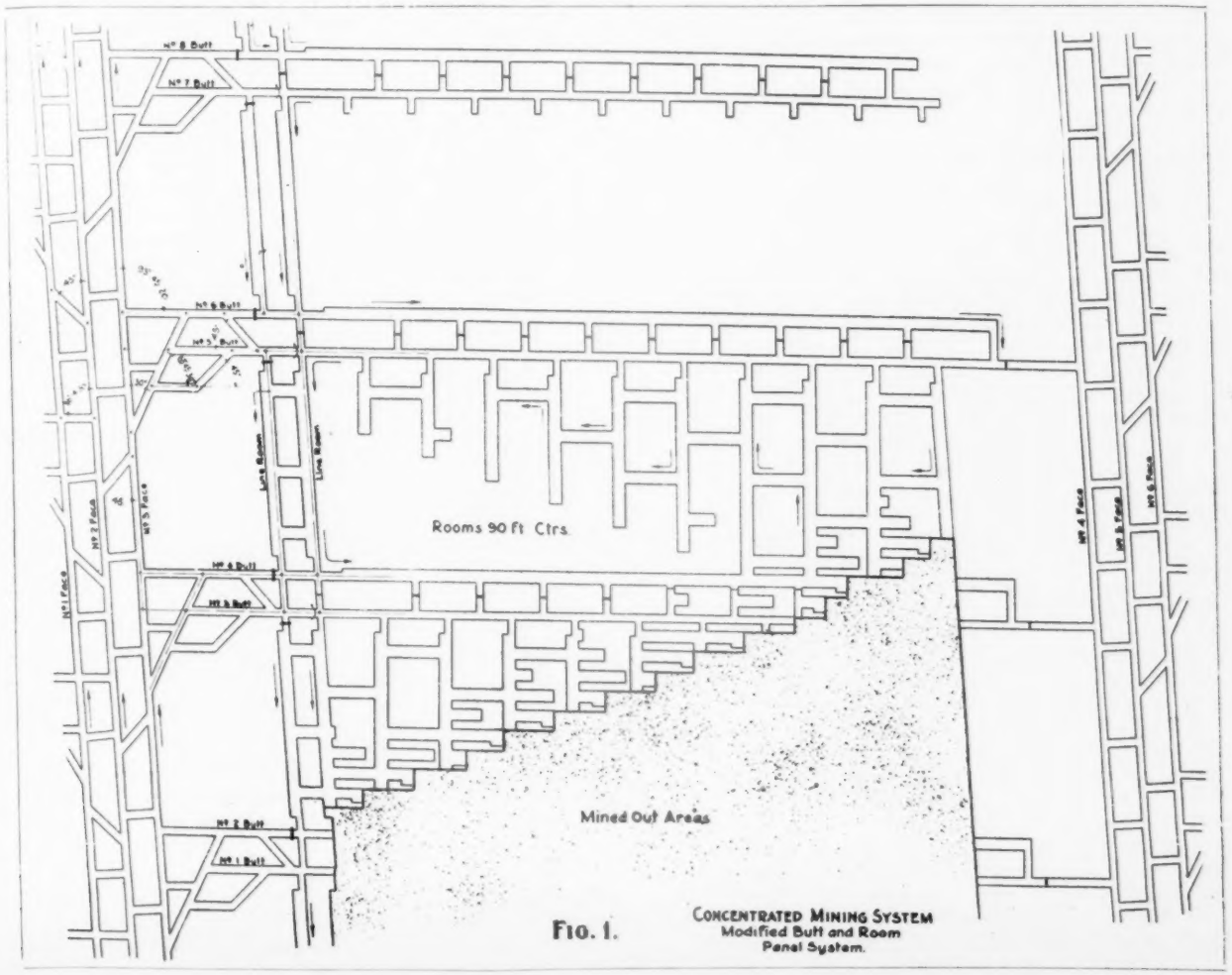


FIG. 1. CONCENTRATED MINING SYSTEM
Modified Butt and Room
Panel System.

sity of slowing down at numerous places or coming to full stops. Starting a full train from rest and accelerating to full speed requires the motors to develop peak loads which have a serious effect on the power plant if energy is developed at the mine and on demand charges and kilowatt hour rate if the plant is on purchased power. The fewer peaks the motors are required to develop, the less the strain on the equipment and the lower the power costs. The writer has known cases where it became necessary to operate locomotives on accurate schedules in order to avoid having a number of locomotives develop peaks simultaneously, tripping out breakers in the power plant so often as to disturb the operation of the entire mine. The details of track equipment require many technical considerations, such as design of frogs and switches, widening of gage on curves, super-elevation of outer rail, etc., which shall be considered later.

Considering the natural conditions characteristic to coal fields in different localities and to individual mines in each field, and considering the wide range in mining practices, first thought might reject a standardization program as impracticable. It is quite true that a standardization policy would be impracticable if it did not provide a range of flexibility and did not permit advantage to be taken of improved methods and equipment. But even considering the ever-changing practices and equipment and the recent rapid developments in the industry, a standardization program that is not bound by hard and fast regulations can be instituted in a practical manner and a consideration of the items mentioned in the foregoing will demonstrate that much can be gained, keeping in mind that standardization is here meant as a means to an end; viz, the study of a subject that when executed will produce maximum results with minimum cost and effort.

Mine Cars

Taking details into account, there are about as many different mine cars as there are mines, one rarely observing the same car at two mines. There is no explanation for this condition, except that forethought, when the industry was young, probably did not anticipate developments on the present scale, and little or no effort has since been made to eliminate the practice of buying mine cars to fit everything else about the mine rather than exercising the proper judgment in designing a car that would result in cheaper coal. Height and pitch of seam, type of mine, methods of handling in shaft or slope or on the tipple, and other factors, of course, greatly influence the size and design of car, but there is no doubt that a little thought would reduce the number of

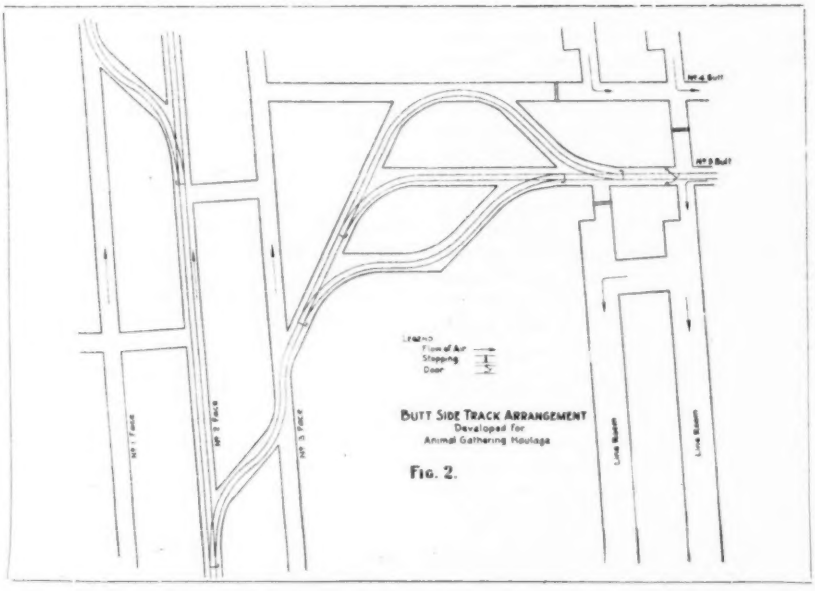


Fig. 2.

designs materially. In laying out a new mine, the design of the mine car should be given no less attention and study than the design of the plant, and that the shaft or slope, the bottom, tipple, etc., should be designed for the mine car rather than the mine car to fit the plant facilities. Track and track equipment should be designed for the mine car and locomotives. If such a policy is pursued, the number of mine car designs will be materially reduced.

Mine cars should be so designed as to result in: Maximum capacity, durable construction, and minimum height; in order to reduce track mileage, to increase the life of the car, and to effect ease of loading. Consideration of these specifications will show that if the capacity of the car is increased, there will be a reduction in the number of cars and trips hauled, resulting in the delivery of the maximum tonnage with the minimum dead weight of car, and in lower labor and power costs. While a standard car cannot be adopted for all mines, the number of designs can be limited to comparatively few, and in many instances one type of car will be found to apply to a large number of mines.

The advisability of equipping cars with roller bearings must be considered specifically and not generally. The problem to be considered is whether the increase in the cost of the cars is warranted directly or indirectly by the probable savings and ease in handling. Various types of bearings have met with both success and failure and a full consideration of their limitations should govern their adaptability to a given application.

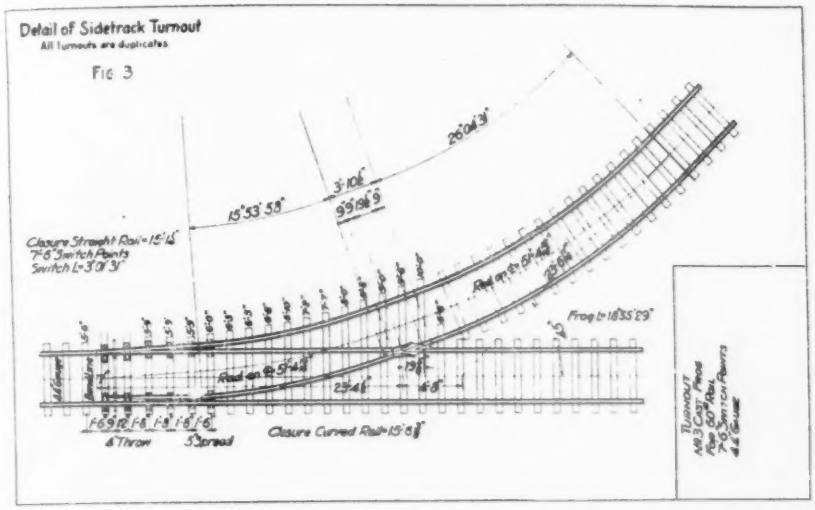
Greasing once in twelve to fifteen months has been recommended, but it is extremely doubtful whether grease will retain its lubricating qualities under constant service for that length of time. Lubricating costs should be estimated on greasing at shorter intervals.

There is a wide range in the friction developed by roller bearings as compared with plain bearings. Accurate tests have recently been made on new cars which show that whereas roller bearings develop considerably less friction than plain bearings on straight and level track, the difference is less pronounced on banked curves and practically nothing on flat curves, where the plain bearing friction is often exceeded. Miscellaneous random tests on cars in service four to five years have shown results in some cases less favorable to roller bearings. In considering power costs, due allowance should be made for the increased friction on track that is not straight.

Where average track grades are encountered in excess of three to four percent it is doubtful whether roller bearings are justifiable.

The weight and capacity of the car should be taken into consideration in the choice of bearings. A light car with small capacity equipped with roller bearings might cost 30 to 40 percent more than a similar car with plain bearings; whereas the difference in cost between large capacity cars might be reduced to 10 percent or less. In the former case it might be well to consider whether 30 percent additional cars would return greater dividends than less cars roller bearing equipped. In the latter case grades, friction, maintenance and lubrication should all be considered.

The size of wheels should be governed by local considerations. So far as friction is concerned, the size of wheels (not



including extremes) has little if any influence.

Gathering Locomotives

The design of gathering locomotives is governed mainly by the tonnage to be delivered and track grades over which trips are hauled, the overall height depending on the thickness of seam. Where butt and room grades are heavy, requiring cars to be delivered to the face, crab and cable reel locomotives are to be preferred. Storage battery locomotives are rendering satisfactory service under favorable conditions, but where grades are heavy and the locomotive worked at or above rated capacity, frequent charging must often be resorted to and the maintenance costs usually high. Under favorable conditions, animal haulage has been found very satisfactory and economical, and all modifying factors should be carefully considered before replacing animals with locomotives. Poor performance is usually due to long hauls or heavy grades, but where grades are favorable and the side tracks properly located, 100 to 125 tons per day per animal is not exceptional.

More modern developments in coal loading machines have required very special track arrangements on butt entries and in rooms in order to deliver mine cars at a rate that permits the machine to operate full time. Many arrangements so far developed, however, have failed to produce the desired results, and machines with a large hourly capacity very often load less than 150 tons per day. Much could be written on this subject, but suffice to say that, where the nature of the coal seam, cleaning facilities, and market conditions permit the use of loading machines, considerable time and study should be given the mining system and method of gathering the coal to side tracks for the main line locomotives.

Main Line Locomotives

The main considerations involved in the choice of main line locomotives are weight of trips hauled, track grades, and rate of travel. Journal and track resistance is quite a variable item, and much higher than ordinarily assumed, especially on cars with trucks out of alignment, bent axles, etc., and on crooked and curved track. Calculations involving journal friction for average conditions should not include less than 30 pounds per ton for plain bearing cars. Serious errors are very often introduced in estimating track grades, even where accurate profiles are available. Curves have the same effect as an increase in grade, especially sharp curves on which the track gage has not been widened or the outer rail super-elevated to release the binding of the trucks. Track grades should be compensated for curves or the proper allowances made. While sometimes considered a negligible quantity, grade compensations on ordinary curves may easily be the equivalent of 4 to 5 percent grade. With the grades and loads properly considered, and the speed of travel chosen, simple calculations will determine the size of locomotive required, although locomotives quite often could be equipped to advantage with larger motors than under usual conditions. Where locomotives are required above 15 to 20 tons, tandem locomotives are preferable, where applicable, for several reasons:—smaller standard locomotives can be used, overall width and height is less, and track requirements are much lighter.

Numerous sizes and makes of locomotives in one mine should be avoided. An excessive number of repair parts must be kept in stock, materially increasing the investment not returning dividends. Usually one or two sizes of locomotives will fill all requirements, and where an occasional light locomotive is temporarily required, a standard locomotive can profitably be used, even though working considerably under its rated power.

Track and Track Equipment

The track required is determined by the weight of the rolling stock traveling over it. Hand books furnish reliable information on the subject. However, the general practice makes use of the following: Rooms, 16 to 20 pound rail; Butts, 25, 30, and 40 pound rail; Main line, 30, 40, 60, and 85 pound rail. The size of ties and rail accessories depend directly on the weight of the rail. Ties are usually spaced 18 to 20 inches for all weights of rail.

In order to insure best and most economic results, the proper weight of rail should be used in order to maintain good alignment and to reduce rolling stock impacts to a minimum. Curves should be properly and smoothly aligned, the gage properly widened and the outer rail super-elevated. Track poorly ballasted and poorly aligned has a very serious effect on the rolling stock, and results in many derailments and wrecks, causing increased expenses and lower production. The practice of allowing these problems to take care of themselves is poor economy and is to be discouraged. Mine track makes frequent use of at least six different gages —30, 36, 42, 44, 45, and 48 inches, and in some instances 24 inches is used. It is possible under certain conditions that odd gages should be chosen, but there seems to be no logical reason why so many gages remain in use. The practice has been started and it will be a difficult matter to eliminate the gages not desirable, but as a matter of economy, one or two gages will survive and will meet all requirements as well as the six or seven.

The subject of track equipment, including frogs and switches, contains many possibilities if properly treated. The practice of allowing the blacksmith to build this class of equipment is poor economy, although many still contend that the blacksmith can build as good equipment as can be purchased and at a less cost. The cast frog for mine use has proven itself superior to the riveted frog, the only frog the blacksmith can build, and the riveted frog is rapidly disappearing. Few shops, if any, are properly equipped to make switches, so that best results are obtained by purchasing these materials from manufacturers specializing in that class of work.

The purchasing of track equipment is a difficult matter without specifications. A tabulation of proposals covering track equipment usually shows a wide variation in prices, and the purchaser is

not qualified to choose the better quotation unless he is equipped with the technical knowledge to properly consider the quality and quantity offered. The purchase of this class of equipment is too often left to inexperienced individuals who rely on recommendations of the manufacturers. And while the majority of the manufacturers are conscientious in their recommendations, they are not usually informed concerning the particular conditions or locations for which the equipment is intended, and therefore cannot properly advise the purchaser. Assuming that the proper recommendations can be made, manufacturers' standards differ materially, and equipment purchased from different sources, not being interchangeable, may produce unsatisfactory results if not kept segregated. Through the efforts of the Committee on Standardization of Track Materials under the auspices of the American Mining Congress, considerable progress has been made and much commendable work has been done, but the standards adopted cannot meet all requirements of all existing mines, still leaving the purchase of a large volume of this class of material to the discretion of the purchaser.

Designs of track equipment should conform in general to the standards adopted by the Mining Congress Committee where the standards cover, but where no standards have been adopted, the same general principles should govern designs in order for best results to be obtained. Such a procedure will still leave the purchase of materials on a competitive basis, as the purchaser's standards can be so designed that the standard equipment of any manufacturer will fit, either as a whole or in part. Specifying the number and size of friction plates, rail braces, connecting bars, size and spacing of ties is necessary for the proper ruggedness and permanence of switches and turnouts, but the designs should be such that rolling stock can easily be moved over same, and on main lines such that locomotive trips can be passed over them at full speed, or practically so, without excessive impacts and jolts.

The practice here recommended has many advantages:

(1) The number of designs is limited to comparatively few, requiring less work on the part of manufacturers.

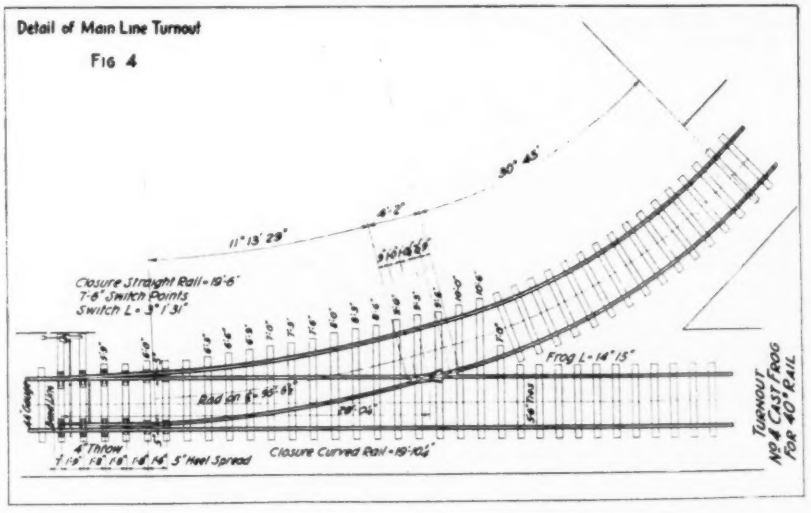
(2) With standards adopted, manufacturers can reduce costs by quantity production, and will be able to stock standard materials in large quantities, placing them in position to offer prompt deliveries at more favorable prices.

(3) Standard materials are ordered from specifications and designs on file, requiring little work on the part of the purchaser.

(4) Competitive bids are received on the same basis, requiring the consideration of but few details to determine the more favorable price.

Detail of Main Line Turnout

FIG 4



The operating advantages, however, are more numerous and important. All parts of switches and turnouts of the same class are interchangeable, so that no part of a turnout is scrapped until completely worn out. Track men quickly become accustomed to routine work, and knowing at all times the track work required in various places, they soon get their work on a systematic basis, doing quicker and better work by reason of better fitting parts. Track work can be laid out and projected with the same careful consideration as mine workings, allowing the proper chutes to be driven as workings develop, instead of afterwards, with the accompanying high cost of slabbing ribs, heavy timbering, etc. Side tracks are placed at the proper locations, avoiding long animal hauls with the resulting high gathering cost. Properly designed track is laid, giving longer life both to track equipment and the rolling stock passing over it.

Ventilation

Ventilation is usually the largest single item affecting power costs, and is in itself a big subject, requiring much thought and careful consideration. But to obtain the best results it should be considered with haulage layouts in order that sufficient area of air courses be provided to reduce the air pressures and velocities, and in order that numerous trap doors be eliminated from the haulage roads with their resulting inconvenience and delays and frequent short circuiting of the ventilating current. Layouts should be so made as to avoid an excessive number of expensive overcasts. While overcasts are necessary and perform important offices, forethought in connection with haulage and ventilating problems will reduce the number to a minimum.

Power Supply

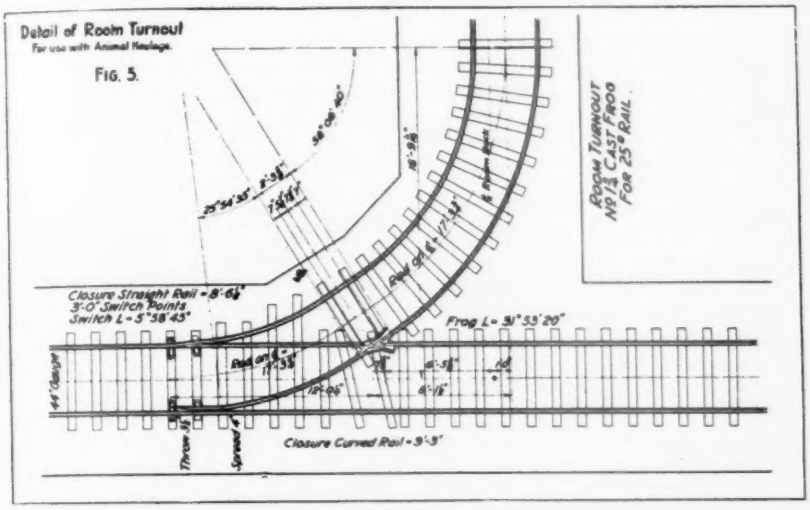
Due consideration to the supply of electrical energy will often produce beneficial results. Inspection of the power supply at the face will very often reveal that where a pressure of 250 to 275 volts is generated at the plant, as low as 150 volts is obtained at the working faces. While pressures as low as this are exceptional rather than the average, reductions as much as 25 to 30 percent are not uncommon. Since the speed of direct current motors is directly proportional to the voltage applied, the first serious effect of low voltage is reduced speed. The motors, however, attempt to develop maximum power and draw heavy current from the line, overheating and overloading the electrical equipment from the power plant to the face. Burned out armatures and field coils run up maintenance costs, and constant tripping out of circuit breakers inconveniences the operations of the entire mine.

A detailed study is required at each individual mine, but the following general considerations will apply:

(1) Electrical energy cannot be economically transported long distances at low voltages. Where mine workings have advanced long distances, substations should be installed in the mine at convenient locations.

(2) Generators should be equipped with series fields for compounding, so that the voltage may be increased at the power plant to partially offset the line drop between the plant and the face.

(3) Main feed and return cables should be of sufficient size to limit the voltage drop to a predetermined value, preferably not more than 10 to 15 percent. A comparison of the cost of copper and power losses compared with the installation of an inside sub-station, with its resulting cost and power losses, is necessary in the matter of determin-



ing the permissible voltage drop and line loss, but where mine workings have advanced a mile from the power plant, with additional distances to go, the consideration of inside sub-stations becomes imperative.

(4) Bonding should be carefully and effectively done to reduce the pressure or voltage required for the return circuit.

(5) Sectionalizing the mine into power supply districts with the installation of sectionalizing circuit breakers will confine short circuits and overloads to the section of the mine in which they occur and prevent the main breakers in the power plant from tripping out and throwing the entire mine momentarily out of commission. As a safeguard against accidents and fires, these sectionalizing breakers are of prime importance.

The foregoing may be considered a lengthy ramification with the greater part of the discussion having no bearing on the subject under consideration, but the subject cannot be treated from narrow viewpoints if the best results are to be obtained. The standardization program must have a flexibility of arrangement to fill existing needs, and must be based on fundamental principles that permit future extensions, necessitated by improved mining practices and equipment, without rendering the adopted standards obsolete. In order to accomplish its aims, all phases of the industry must of necessity be taken into account in order that the subject may be properly and competently considered and applied to a wide range of mines and mining conditions. The foregoing touches lightly on the more important phases of the industry having a direct bearing on transportation problems and their ultimate effect on production costs.

The standards adopted for the track work illustrated in the accompanying cuts took into account the main line haulage, gathering haulage, mining system and ventilation. Figure 1 shows the mining system developed for rapid recovery and concentration of working areas. The system is mined "full retreat," the rib line shown representing the theoretical relation between the ribs and advance workings at any period. Under this system all working places are advanced on sights, including the breakthroughs and chutes for motor haulage.

Figure 2 shows the layout for the butt side tracks, which have a capacity of 12 to 14 cars on both empty and loaded storage tracks. It will be noted that this side track was developed for use with animal haulage on the butts and to permit the main line locomotives to enter the butt to the inby end of the side track. To provide against large unsupported roof areas in mines with unfavorable roof conditions, each chute and break-through was laid out so as to be backed with solid rib on the opposite side of the entry. The return air being conducted through the line rooms, no trap doors are required between the main face headings and the side tracks, and only one door between the side track and butt.

Figure 3 shows the details of one of the side track turnouts, all of which are duplicates.

Figure 4 shows a turnout on the main line, using No. 4 cast frogs and 7 ft. 6 in. switch points. Under special conditions, No. 6 frogs and 10-in. switch points are used, such as on shaft bottoms where motors are often required to pass over switches at exceptionally high speeds.

Figure 5 shows a room turnout for animal haulage. Where gathering locomotives are employed, No. 2½ frogs are generally used.

Complete specifications are kept on file covering each of the above switches and turnouts, including frog number, length of switch points, friction plates, rail braces, connecting bars and lugs, and parallel ground throw switch stands; also covering switch throw, heel spread, track gage, and weight of rail. Blue prints showing the details of the switches and turnouts are furnished the mine, and the necessary breakthroughs, chutes, etc., driven on sights set by the engineering corps.

The details connected with the designs required considerable work, but since the standards were adopted, work has been simplified in all departments. Projections are made to cover track work and locomotive haulage as well as mine workings. Before these standards were adopted, projections were constantly being held up and mine workings advancing more or less unmethodically, all on account of lack of time on the part of operating and engineering officials to give the necessary personal time to the layouts. Since the standards have been adopted, the work goes through routine channels without unusual delays and the resulting inconvenience to the mine.

The coal mining industry generally is still laboring, to a certain extent, under precedents established, and to a lesser extent is following past practices. However, the past few years have seen great strides in advancement. All classes of equipment are being changed and improved; electricity is finding almost universal application; and the industry generally is improving and progressing at a rate comparable with other industries. Due to the increasing labor rates and increased cost of materials (also influenced mainly by labor), production costs have been mounting higher and higher. In order to get the cost of coal back to a more reasonable figure, skillful engineering and efficient management are being employed more extensively than in former years. "Standardization" has been one of the results and standardization of underground transportation will contribute its share toward reduction in production costs.

The Interior Department Appropriation bill reported by the State Appropriations Committee increases the appropriation for investigation by the Geological Survey of mineral resources of Alaska by $13,000 and for examination and classification of lands by $40,000. It decreases the appropriation of the survey for topographic surveys by $73,300, the appropriation being fixed at $451,700. The land classification fund is fixed at $240,000 and the Alaskan mineral investigation at $63,000. The total appropriation of the Survey is decreased from $1,852,740 to $1,832,440.

It has been estimated that from 1916 to 1924, strikes in industry have cost $10,364,000,000.

STANDARDIZING MINE VENTILATION

A Discussion Of Various Types Of Mine Fans And Their Characteristics, Together With Discussion Of The Economic Features Of Fans And Airways—Misconceptions As To Relative Sizes Of Air Intake And Discharge, Power Costs And Differences Between Blowing And Exhausting Explained

By RICHARD D. MADISON *

SOME of the earliest uses for the centrifugal fan have been for mine ventilation, many of the fans having been designed purposely for that use. The mining profession can therefore be justly proud of its share in the constant development of this very useful apparatus which has found such a widespread application in the various industries. Some of the earlier mines looked upon ventilation as a necessary evil—the less the ventilation, the less the evil. Today both large and small mines recognize that it is not only their duty to safeguard their men's health and lives, but that there is an economic advantage in mechanical ventilation which more than justifies the outlay.

While fans have been built for well over 200 years, it has been only in the last 30 or 40 years that the multiblade fan has been brought out and has found such large usage. The earlier type of fan was usually a large diameter, deep radial blade fan operating at rather low rotative speeds. Many of these fans showed good efficiencies, especially if furnished with a scroll housing and evasé discharge and constructed of steel plate throughout. Improved fans of this character are largely used today where high temperatures and pressures are encountered as, for example, in induced draft work, sintering of ores, etc. The multiblade fan has in most cases replaced these earlier units on account of their lighter weight and lower cost of construction. In general the fans are more efficient than the older types and more adaptable to connection to present day prime movers.

The multiblade fan is characterized by a large diameter of inlet in respect to the outside wheel diameter and it has many blades which are shallow in depth compared with their length axially. There are three general types depending on whether the blades are bent forward or backward at their outer edge or whether they are substantially radial. If we consider the radial multiblade fan as operating at moderate speed, the ordinary forward curved blade fan will run at 15 to 25 percent less speed to give the same air and pressure, while the backward curved blade fan will run at 30 to 40 percent higher speed for like conditions.

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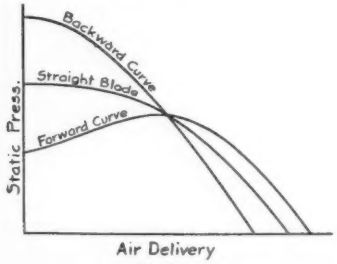


FIG. 1

The pressure curve of a straight blade fan is reasonably flat near the no-delivery condition but by curving the blades forward in the direction of wheel rotation the pressure will rise, while by sloping the blades backward the pressure will fall in a manner somewhat as indicated in figure 1. Although a few of the earlier European fans were constructed with backward curved blades there seem to be few, if any, in use in this country. The reason for this disfavor is probably due to the idea that the higher speed fan is less safe since otherwise there are several reasons recommending it for this service. The writer believes that in time this objection will disappear since fans of this character are operating in most power plants at considerably higher speeds and pressures and the utmost is required of them in the way of reliability and continuity of service.

The actual shape of the pressure curve of a fan is probably of less importance in mining work than in most other applications, due to the relative stable condition of air quantity and air pressure throughout the daily run. There are, however, certain conditions where the shape of the pressure curve should be considered. Two fans with a pressure curve as shown in figure 2 (usually characteristic of forward curved multiblade fans) should never be connected to blow air into or exhaust from the same drift at the same time without first looking carefully into operating conditions. It will be noted that in some cases there may be two different fan capacities delivered under the same pressure at the same speed. In such a case there is the danger that the air load on the two fans will become unbalanced; that is, that one will operate at a higher capacity and the other at a lower one. Consider, for example, that two fans each of 100,000 c. f. m. are to operate at 2 inches w. g. as indicated by the rating "A" in figure 2, the total mine resistance being 2 inches to pass 200,000 c. f. m Even a slight disturbance may cause one fan to drop to the rating at "B" and the other to increase its rating to the point "C." In the case cited, the total output would drop from 200,000 c. f. m. at 2 inches w. g. to 190,000 c. f. m. at 1.8 inches. Just what capacities the fans would assume, if indeed they would become unbalanced, would depend upon the shape of the pressure curve. There is no good way to determine this except by a cut-and-try method; that is, if two points of rating can be obtained from the pressure curve such that their static pressures are equal and the square of the ratio of their total capacities to the mine capacity equals the ratio of the common fan pressure to the mine pressure, an unbalanced condition will result. In the example cited,

$$\left(\frac{45{,}000+145{,}000}{200{,}000}\right)^2 = \frac{1.8}{2}$$

and therefore the fans would give trouble. The disadvantage of such an arrangement is apparent, for although the total capacity of the fans is not materially altered and even might go unnoticed, neither fan would be operating at its best point of rating. Thus it is easily possible for the combined efficiency of the two fans to drop from an expected 75 percent to 60 or 65 percent. This same difficulty is also likely to occur in a double width fan having such a pressure curve.

Another case where the shape of the pressure curve is of importance is in the selection of a fan where the mine resistance is not known and it is desirable to choose the fan for a definite speed or at least within narrow speed limits. In such cases the fan with a steeper pressure curve is of distinct advantage. It can readily be seen that if the pressure curve is rather flat at the point of rating, a slight change in resistance means a large difference of capacity and, if the mine resistance is much different from that estimated, a large speed change will be necessary to cause the desired amount of air to pass

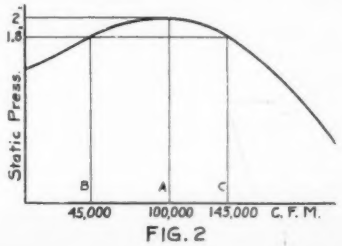


FIG. 2

through the mine. On the other hand, a fan having a steeper pressure curve will accommodate itself more nearly to the estimated condition and will require somewhat less change in speed to pass the desired amount of air.

The horsepower characteristics of a mine fan are of relatively small importance. Needless to say, a fan of high efficiency should be selected. It occasionally happens that a fan is selected for a given air quantity and pressure and when installed the mine resistance is found to be different than originally estimated. The fan speed may be changed to obtain the desired air quantity, but in doing so the fan will be operating at a new point of rating which may be somewhat less efficient than the rating for which it was selected. Moreover, fans are usually made in standard sizes which fact necessitates the selection of the nearest size to meet the mine conditions. For these reasons, the efficiency curve of the fan should not only reach a high point but should be reasonably flat in that region so that a small variation from the desired mine conditions will not materially alter the fan efficiency. The manufacturers of fans are usually very willing to furnish characteristic curves of their fans for sizes and speeds quoted upon and thus aid the purchaser in the proper selection to meet any special needs he may have.

Of the three types of multiblade fans there is very little difference in the maximum efficiencies obtained. Other things being equal, the high speed fan with backward sloping blades should show somewhat higher efficiencies, but as mentioned before this type of fan has not yet come into common use for mine ventilation, at least for primary ventilating fans on the surface. Of the other two types and for a given capacity and pressure, the forward curved blade fan should show higher efficiency for the higher outlet velocities while the straighter blade fan will be somewhat more efficient at the lower outlet velocities. In speaking of efficiency the mechanical or total efficiency has been referred to in all cases—that is, the ratio of horsepower output on the air to the horsepower input on the fan shaft. This is what the purchaser is vitally interested in since it can readily be interpreted in dollars and cents. The terms, manometric efficiency and volumetric capacity, are archaic and little used today. First cost, operating cost and serviceability are the real items of interest to any fan user.

The mining profession is well aware of the relative advantages of the reversible fan when arranged primarily as a blower or as an exhauster. The local conditions will dictate which type to use if, in fact, the reversible fan is the proper one. Certain local conditions may be such that the reversing of the fan would be a positive source of danger in case of a mine disaster and therefore a non-reversible type would not only be the cheaper but also the safer one to install. However, the reversible type of mine fan is that preferred by most companies and the extra cost is small compared with the advantages that exist in the majority of cases. If the fan is to be reversed while in operation, that is, reversed from a blower to an exhauster or vice versa, as may be desirable if the fan is not too large, the doors should be manipulated in a manner so that the fan is not allowed to operate at free delivery. The horsepower under such a condition may well attain two or three times that for normal operation. In this connection it might be well to mention that the single inlet exhaust fan exhibits more end thrust than the blower, in either case the thrust being toward the air inlet and not away from it. While thrust loads are ordinarily not large, it is well to provide lubrication against the thrust faces which are preferably contained entirely within the bearing shell. Double inlet wheels and wheels not having a center plate are practically balanced against thrust. It should be noted also that in the erection of fans the wheel inlets should be set as close as practicable to the housing inlets in order to reduce the short-circuit losses which are present in any type of fan.

While the mine operators desire the highest efficiency obtainable from their fans and power equipment they often overlook the point that the real saving in power can best be made in the flow of air through the underground passages. Many of the methods employed in cutting down power necessary for mine ventilation more than justify the expense incurred. This is especially true of new mines since by careful planning of the airways and providing for future expansion as the mine is developed, the expense of producing an efficient ventilating system is materially reduced. Only too frequently does it happen that the ventilating needs of a mine are neglected in its early development and costly changes are later required to correct for this difficulty.

It may seem needless to remark that airways should be as smooth and straight as possible and yet this is of vital importance. The nature of the surface against which the air rubs may easily make 10 to 20 percent difference in the power required to force this air along. More important yet is the sudden shock caused by abrupt turns or bends or exposed timbering which contracts the air stream with ensuing loss of pressure on the discharge side. Many of the turns must be made at right angles but the attendant losses can be lessened by rounding the inner radius. Both corners of an entrance may be rounded off where the air enters around both of them, as in break-throughs between large rooms. Where doors or curtains are placed to deflect the air into other entries or rooms, it is well to place them as close to the room or entry as possible instead of leaving a long dead pocket of air on the fresh air side.

More and more, mines are smooth surfacing the haulage shafts and fireproofing them. Since usually all of the ventilating air either enters or leaves through this shaft, the total mine resistance can thus be materially lowered, especially if the mine is a deep one. While it may not pay to smooth surface the air shafts in some cases, it will in many if the mine is deep and the shafts reasonably permanent. Besides, higher velocities are ordinarily permissible in the air shafts so that by smooth surfacing these a proportionately greater saving in power may be obtained. As a means of further lessening the power on the air shafts, the latter are frequently sunk with a circular cross-section thereby offering the minimum of rubbing surface for the volume of air transmitted. For this reason a square shaft is better than one of rectangular shape. These relations may be expressed in formulae as:

$$w = 1.149\sqrt[5]{\frac{(a\,b)^4}{a+b}}$$

$$d = 1.1w = 1.265\sqrt[5]{\frac{(a\,b)^4}{a+b}}$$

where, d = diameter of round shaft,
w = width of square shaft,

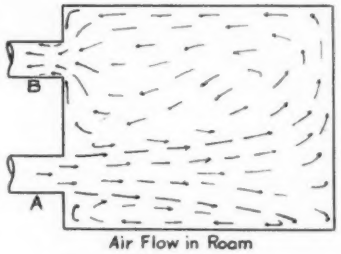
and a and b are sides of rectangular shafts, all having the same air friction for the same length to pass the same cubic feet of air per minute. From the above it will be observed that the diameter of a round shaft is 10 percent greater than the side of a square shaft to pass the same air quantity with the same friction per running foot, but the amount of material excavated will be about 5 percent less.

The safest way to insure a reasonably low mine resistance is to make the important air passages of large cross-section thereby keeping the velocity of the ventilating current low. It may be shown that the power required to send a given volume of air through a passageway varies as the perimeter of the section divided by the cube of the cross-sectional area. Thus, if a square shaft is enlarged to twice its original area and the same volume of air sent through it, the shaft friction would be only 0.177 times as much as originally. Even a slight increase in area will drop the friction and consequently the horsepower an appreciable amount; for, if each side were enlarged only 5 percent, necessitat-

ing the removal of about 11 percent more material, the saving in power would amount to about 22 percent of the original.

As far as possible the air should be divided into splits or districts near the downcast shaft, maintaining them distinct from each other and uniting them near the upcast shaft. Where the mine is developed mainly in one direction or where it is feasible to have more than one air shaft, the air shaft should be placed at a convenient point some distance from the mouth of the mine, thereby obviating the necessity of long underground return passages and some overcasts. True, this means that one or more fan houses must be built and at quite a distance from the main buildings; but if the fans are driven by electric motor and operated through remote control and all bearings are supplied with thermostatic alarms, only occasional trips of inspection need be made to these outlying houses. Where extensive operations are planned the main headings should be driven on the multiple entry system, both to provide ample airways and also trackage facilities. In many cases it would be economical to plan a two division main split, using the three entry system to develop one side of a property and when it has progressed well, change over to the five entry system to take care of the other side. Where the coal or ore is mined on several different levels, the air should be split and taken off at the various levels and proportioned according to the needs of each, instead of carrying all of the air to the bottom level and allowing it to work its way upward. Such a method furnishes a better and more uniform atmosphere for the miners to work in and in addition reduces the air friction and horsepower. As some air is taken off at each level, the velocity of the remainder is lessened if the shaft does not change in size. Since the velocity drops there will be an accompanying regain of static pressure in a manner somewhat similar to that existing in the evasé fan discharge. If the air shafts are downcast and the lower workings are extensive then high entrance velocities in the shaft may not be so uneconomical of power as might be supposed, for the lower levels would thus be favored and less dampering be required for the upper levels to effect a proper distribution of the ventilating currents. On the other hand, if the upper workings are more extensive than the lower ones, which would be the natural mining method, except as the coal or ore body varied considerably in value, the air would naturally assume a more uniform flow without so much necessity for any kind of regulation between the levels.

Dampering is expensive and the less of it required the less will be the power required on the air. Of course, some dampering will generally be necessary in order to regulate the volume of air passing to the various districts, but every one must admit that the damper is in its very nature a waster of power. The writer does not mean to convey the idea that dampers should be eliminated unless other alterations are made which warrant their removal or change of setting. Consider, for example, that one of two splits is handling 100,000 c. f. m. with a resistance of 1 inch w. g. If the other split is to pass 50,000 c. f. m. at 1¼ inch w. g. a regulator must be



Air Flow in Room
FIG. 3

supplied to offer one-fourth inch resistance to the 100,000 c. f. m. to balance up the distribution and in doing so adds 2-15 or 13 1-3 percent to the theoretical power required for the total. In the interest of economy an effort should be made to reduce the friction on this smaller split, either by enlarging some narrow passages, cleaning up the falls, smoothing the walls, easing the air at turns or other means, such as effecting the split at a more advantageous point. It should be observed that in no case will it avail one to reduce the friction in the split already having the lesser friction since then the regulator must be still further closed to properly proportion the air volumes. If the dampers were removed entirely in this case and no other change made, then the split with less friction would rob the other of part of its air delivery, which to be restored would necessitate an increase in fan speed and total amount of air delivered and would probably require 10 to 12 percent additional power.

In the case of new mines it will pay to plan the ventilating system with great care and also keep a constant check upon it as the mine develops. Very often an old mine reaches the point where it becomes uneconomical to further increase the air capacity by increasing the fan speed. In such cases a careful inspection should be made to determine how the mine resistance can be lowered. The mistake should not be made of remedying certain bad conditions just because they are known to exist and are the least costly to make. They may be in a part of the mine already partly shut off by regulating doors and as far as the ventilating cost is concerned such labor would be wasted. The leaky stopping, the long run or crooked entry where large volumes are being coursed and the resistance highest, is often the place where the remedy might seem to cost the most but which is likely to be the key to the situation and by far the cheapest way out.

The judicious use of secondary ventilating equipment will help a great deal to keep down power costs at the same time insuring good ventilation at the working faces. The booster fan also will relieve trouble in many cases where some districts are much longer than others. For the sake of safety the booster fan operating any large district should be motor driven and capable of being controlled from the surface. The disk type of booster fan is less used than formerly owing to more strict mining laws and also to the fact that it is less efficient than the centrifugal booster which has largely displaced it. Still, it has the advantages of being more easily reversed and costs less. If the fan is to produce a pressure difference greater than one inch the centrifugal type of booster is generally selected.

In closing the writer wishes to point out a few misconceptions which frequently appear in mining literature. One is the argument over the relative size of the air intake and discharge which is usually based upon the increase of air volume due to gas, air drills, temperature change, etc. While all of these may be considered if one so desired, as a rule they are of relatively small effect, the main thing determining the size of the air shafts being the velocities in them. Thus an upcast shaft could be made round and fairly smooth thereby economically permitting a higher velocity than in the downcast shaft which might necessarily be kept fairly low for haulage purposes. In such a case the upcast shaft could be smaller even though passing a somewhat larger amount of air.

Again, some would give us the impression that the cost of power for ventilating purposes greatly exceeds that for hoisting the coal to surface. This conclusion is arrived at by calculating the weight of air moved and comparing it with the output of coal in tons. True, the weight of air circulated may equal and often exceeds the weight of coal or ore lifted to surface. In the former case, however, the columns of air in the two shafts are more or less balanced in weight and power is used only to circulate it against the mine resistance, while in the latter case the coal is a dead lift to surface and the power depends upon the weight (*Continued on page* 286)

Magnolia tree between the U. S. Treasury and the White House *© Horydczak*

When Spring first comes to Washington

STANDARDIZING NON-METALLIC MINERAL PRODUCTS*

Non-Metallic Mineral Industries Are Highly Competitive—Successful Operators Are Those Taking Advantage Of Every Improvement In Mining Methods And Machinery To Lower Costs And Produce Uniform Products—Efficiency In Production Of Non-Metallics Lower Than Other Branches Of Mining

By RAYMOND B. LADOO†

THE term "standardization" can not be applied to nonmetallic mineral products in the same sense that it is used in many industries. Instead the term to be used should be "uniformity." Most nonmetallic minerals are mined and milled and sold without greatly altering their original, natural, physical, and chemical properties. But great differences exist between minerals of the same general type found in different deposits. Thus it is obvious that we can not standardize mineral products in the same way that we can standardize sizes of automobile tires or screw threads. For example, there are many types of talc, all differing from one another to a greater or lesser degree, in one or more physical or chemical properties. New York fibrous talc and Vermont foliated talc are so entirely different from each other that they are almost noncompetitive. Yet each is a desirable product and has its own uses. No amount of human labor or ingenuity can make these two talcs conform to a single type standard.

It is evident, therefore, that we should use the word "standards" with caution, if at all, when dealing with the nonmetallic minerals. What we really wish to achieve is uniformity of product from any given deposit or mill, together with the highest quality possible, having in mind the limitations imposed by the nature of the material itself, the use to which it is to be put, and the price for which it must be sold. The consuming trades want a uniform product, of the best quality possible, at the lowest possible price. These are the essentials of successful production.

By uniformity of product we mean not only that all of the material in a given carload shall have substantially the same physical and chemical properties but also that month after month and year after year the quality shall remain the same. To achieve such uniformity over long periods the producer must own or control extensive deposits of crude ore. He must have these deposits carefully examined and many samples analyzed or tested far in advance of mining to determine the quality, quantity, and uniformity of the material which he must mine in the future. In mining he must be alert for differences in beds or veins, for pockets or streaks of impurities, and for gradual changes in character and composition of his ore. He must mine and handle his product so that uniformity will be assured. In the mill the same care must be taken. Mill samples should be taken at frequent and regular intervals and tested to see that there are no variations in milling. Finally, each shipment should be sampled and tested before it leaves the plant. Records should be kept of all samples and analyses.

Some deposits run very uniform naturally, but there are very few which are so regular that all forms of systematic testing can be dispensed with. In some cases, simple check tests should be made as often as every hour.

The small producer often sells his output through a broker or jobber and thus has little or no contact with the consumer. This contact is highly desirable for it enables the producer and consumer to understand each other's problems. Few small producers know exactly what are the needs and problems of the consumer. He often does not understand how much it costs the consumer in dollars and cents when a lot of finished ware is spoiled due to impurities or lack of uniformity in raw materials. To the maker of chinaware, for example, the costs of his clays and feldspars are very small compared to the value of his finished porcelain. A carload of off-grade clay, costing $500, may cause many thousands of dollars in losses. Such a consumer can not afford to take chances with his raw materials, and he will buy from the source which he believes best insures proper quality and uniformity, together with a reasonable price.

One nonmetallic mineral industry in the South has declined considerably in importance in recent years because the producers persisted in furnishing nonuniform material and attempting to sell it at the top prices for best quality material. Few, if any, of the producers realize what is wrong, but consumers know and buy elsewhere. The quality of the raw material in this case is equal to or above the average, but the producers are small, poorly financed, and either do not know how to improve the preparation of their product or are contented with conditions as they are.

In another industry one producer in the South has for some years practiced the methods of careful sampling and testing outlined above, and he has been rewarded with a very large increase in business. He has demonstrated that careful control of quality and uniformity pays big dividends.

It seems trite to say that, in the last analysis, profits are the sole aim of all industry. Yet this essential seems to be often overlooked. Many nonmetallic mineral industries today are highly competitive, and the most successful operators are those who take advantage of every improvement in machines and methods which will lower their costs and produce uniform products. Yet many producers of minerals are content to dig out their materials by hand labor and prepare them for market by inefficient and antiquated methods. In general, it may be said that the efficiency of production of the nonmetallic minerals is far lower than in any other branch of mining.

Some one has said that metallurgy is the science of extracting dollars from ores. It can be said with equal truth that nonmetallic mineral technology is the science of extracting dollars from mineral deposits. The most efficient and successful producer is the one who produces most dollars of profit per dollar of capital invested. Since dollars of profit are what every producer seeks, it is obvious that mineral technology should play a very important part in the production of the nonmetallic minerals.

In the past complaints have often been voiced against the quality and lack of uniformity of certain domestic nonmetallic minerals, particularly some of those which have been produced in the South. These complaints, which unfortunately have often been justified, have greatly retarded the development of some domestic deposits and encouraged the use of imported materials. It may not be wise to mention specific cases, but numerous examples could be cited.

In order to attack the problem efficiently let us first analyze the causes and then consider the possible remedies. Of course, it will be understood that all of the causes do not apply to any one specific mineral. Some of the causes of inefficient production are as follows:

1. Small size of producing companies prohibits employment of able managerial and engineering talent.

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* Presented at Industrial Development Conference of American Mining Congress, Memphis, Tenn., March 15-17, 1926.

2. Insufficient capital to finance improvements in machines and methods.

3. Lack of proper knowledge of consumer's requirements and his problems.

4. Low prices due to excessive competition.

5. Too great conservatism among some producers.

6. Technology of nonmetallic minerals is more complex and not so far advanced as that of the metals.

7. Too many producers and far too great producing capacity for country's requirements.

8. Low labor costs have retarded use of machinery. If the South continues to expand industrially at its present rate this factor will soon be eliminated.

Few of the above causes require explanation, for they are all more or less obvious. The remedies, unfortunately, are not so obvious or simple. Some of the ways in which greater efficiency may be made possible are discussed below.

1. *Cooperative Engineering and Sales.*

In an industry made up of a number of small individual producers it might be possible for these producers to band together and finance an engineering and sales company which would have technical control over the production of all member companies and which would market all of their products. This is being done successfully, so far as the marketing plan is concerned, by the structural slate producers of Pennsylvania.

The drawbacks to this plan are: (a) The difficulty of selling the idea to the present producers; (b) no provision is made for financing improvements which may be necessary; (c) difficulty of arriving at a fair and satisfactory basis for apportioning production among member companies; (d) possible legal difficulties with Federal Trade Commission.

2. *State or Federal Assistance.*

Improvements in technical methods and processes might be brought about by cooperation between producers and Federal or state agencies, such as Bureaus of Mines, which now exist or which might be brought into being. This work would resemble that now being done by Federal and state Departments of Agriculture and agricultural experiment stations. The difficulties here are: (a) No provision for financing of improvements; (b) growing opposition to extension of paternalistic functions of Government; (c) no curb on present or potential overproduction with its attendant excessive competition and undue price cutting; (d) low pay of Government officials would not attract and hold high type of men needed, and its corollary; (e) no financial inducements to technical workers to achieve most profitable results.

3. *Combinations or Consolidations.*

This is an era of big business, of large scale production, of low prices, and of small profit per unit of sales. Profits are made today by doing a large volume of business on a small margin of profit, rather than by doing a small business with a large margin of profit. Generally speaking, the time has passed or is rapidly passing when a small producer with limited capital can run his business efficiently and profitably. Low prices are forced on him by competition. To compensate for low prices he must cut his costs, make better products, and increase his volume of business. To do this he needs more capital, more and better machines, and the best managerial and technical talent that can be procured.

It may be argued that some mineral industries, from their very nature, do not lend themselves to large-scale production. It is true that few mineral industries can ever hope to become really large compared with such industries as automobile manufacture or the petroleum industry. But it is also true that many mineral industries can be more profitably operated in much larger units than they are today. It must be remembered that there are at least three different kinds of combinations possible, namely: (1) Combinations of producers of the same raw materials; for example, a merger of lime companies. (2) Combinations of producers of similar or related minerals; for example, minerals used by the paint trade, such as ocher, whiting, barytes, etc. (3) Combinations of producing and consuming companies; for example, a porcelain tile company and a kaolin producer. Certain large companies today represent combinations of all three types at the same time; for example, the Anaconda Copper Co. Thus size and strength may be acquired in several different ways.

The difficulties in the way of forming combinations are several. Legal difficulties are, fortunately, becoming fewer, due to broader-minded interpretations of our antitrust laws. We have learned that large corporations are not necessarily wicked just because they are large. Financing large mergers is often thought by laymen to be very difficult, but it will usually be found that money in large quantities can be readily obtained to finance meritorious projects.

The real difficulties are to find the right men to operate the larger companies and to persuade present producers to enter a merger with fair prices upon their properties. Both are of great importance, but the first is vital. A great company with adequate capital and good deposits may fail badly unless proper men may be found to run it. We all can probably think of examples of money, resources, and opportunities wasted because of poor management and poor organization. Able personnel can make a good venture better and can often make a success of even a poor undertaking, while incapable management will ruin both.

The second difficulty is also a very real one. It is usually very difficult to persuade a small producer who is now earning a good living and is absolute boss of his little domain to give up his position and play a less imposing part in a much larger company. He is content to let well enough alone. He can not see that, sooner or later, he will be forced out of the running. Even if he does finally agree to merge or sell out he has such an exaggerated idea of the value of his property that no one can afford to deal with him. Unfortunately, in many or most of such cases bankruptcy stares him in the face or overwhelms him before he will listen to reason, and then it is often too late. We all can think of many examples of this. Hindsight is clearer than foresight, but it comes too late.

Fortunately, or unfortunately, depending upon your viewpoint, this country and the South in particular is rich in deposits of most of the nonmetallic minerals. Good deposits of many minerals are so common that their value is nominal unless or until some one creates value in them by successful and profitable operation. This abundance of deposits encourages many people with small capital and less knowledge of the business to start new companies. They usually fail, but there are enough new ones in business at any one time so that there is always a large potential over-production. This situation, however, has also another effect. When large interests are desirous of forming a merger or a corporation to produce one or several minerals on a large scale, and when they find that present producers are unwilling to work with them or set a fair value on their properties, it is usually possible to buy unworked deposits and start new operations.

This is, of course, an economic waste, for it adds still more to excess plant capacity and, in the end, the shortsighted, small producer is forced out of business. This has happened many times in the past and is still happening. I know of one industry now which already has 200 percent more producing capacity than the country needs at peak load. Yet there are now under construction or soon will be enough new plants to increase the excess capacity another 100 percent. Sheer economic waste! Excessive competition and inefficient, small scale, costly production leave little or no margin of profit. Deposits are ruthlessly butchered and as much material wasted as is saved in an effort to cut costs, and lower and lower grades of product are made. By large scale, efficient production costs and prices may be lowered, our mineral resources conserved, and better and more uniform products sold.

In conclusion (*Continued on page* 266)

The United States Treasury Building

LEGISLATIVE REVIEW

Congress Nearing Adjournment—Get-Away Slated For June—Session Marked By Systematic Manner In Which Various Measures Have Been Disposed Of—Silver Bill Strikes Snag—War Mineral Relief—Coal Control—Muscle Shoals Bids

WITH the major legislative program nearing completion, congressional leaders are planning adjournment of the session of Congress early in June. The tax revision bill has been enacted into law, the railroad dispute settlement legislation is nearing completion, and other miscellaneous bills on the administration's program are approaching such shape as to point the way toward early adjournment. For many reasons the administration considers a long drawn-out session of Congress to be a disturbing element to the prosperity of the country, as it injects uncertainty in business and promotes criticism of government and private activities. Left undisturbed by legislative interference, the country can chart its course and proceed without undue restriction. Another factor contributing to early adjournment is the approaching congressional and senatorial campaign and election in November. All of the 435 members of the House and a third of the 96 Senators are up for election. Congressmen consider that it is just as much a part of their official duty to mingle among their people and observe conditions in their states and districts in order that they may know the actual conditions existing in the country, in order to guide their legislative acts, as it is for them to sit in the chambers of Congress and pass laws for the country. Without this close contact they can not interpret the people's views on legislation nor vote intelligently for the good of the country.

The present session of Congress has been marked by the earnest and systematic manner in which Congress has taken up and disposed of the various legislative proposals. Every issue has been squarely faced and no disposition shown to sidestep any proposition. The bills are taken up in the order of their importance and either passed or rejected as warranted by their merits.

The railroad labor dispute adjustment bill was passed by the House and is slated for early debate in the Senate. The Senate has considered a bill which would forbid railroads from charging more for a short haul than for a long haul, in which consideration has been given to rates on coal and steel. In the House it was suggested that the railroad dispute bill be amended to include settlement of coal mine disputes, but it was not seriously pressed, and the disposition has been to confine this legislation to the railroads, as the matter of settlement of coal disputes has not been seriously considered by any congressional committee from which a conclusion might be reached.

Mining Bills

Mining legislation continues to occupy a conspicuous position in the proceedings of Congress. Unexpected opposition developed to the bill directing the Treasury to purchase 14,000,000 ounces of silver at

$1 per ounce to complete purchases under the Pittman Act of 1918. This criticism came from six of the seven Democratic members of the Banking Committee which had previously reported the measure. These opponents support the Treasury Department in its opposition to the legislation, and their position is likely to prevent action on the measure, which was passed last session by the Senate. The proposal of the Forest Service to restrict mining in national forests still lies dormant in the Senate Public Lands Committee and no Senator has been willing to introduce the measure, which prevents its consideration. The Senate Public Lands Committee, which has been investigating various public lands questions, has been given until March 4, 1927, to complete its investigation, which has involved various mining proposals.

The rights of war mineral producers continue to be recognized by Congressmen who have introduced bills to allow war mineral claimants to appeal from decisions of the Interior Department on their cases to the Court of Claims.

Bills have been reported from committee to allow prospecting permits and leases for potash and for a five-year survey of potash deposits and potash recovery methods by Government agencies, looking to development of the industry. The Senate has passed, and the House is likely to soon act on, a bill which would extend for two years the time in which oil and gas permittees may perform drilling operations. Proposals to give preference in leases in the Red River oil region to former claimants under the mining laws who were ruled out by a court decision have also been proposed.

Confiscation of oil and other rights of Americans in Mexico has been criticised in the Senate, which has called on the State Department for information on the subject.

Coal Control

Among recent coal proposals advanced in Congress are measures to authorize the Government to buy and sell coal at reasonable prices during emergencies. Other bills create a Federal anthracite corporation of seven members, with a capital stock of $600,000,000, to operate anthracite mines during strikes, and to authorize the Departments of Commerce and Labor to conduct investigations for adjustment of wages and prices in the anthracite industry. Another bill proposes a bureau of coal industry to conduct various investigations looking to the determination of a sound public policy regarding the industry.

Further legislation has been proposed to forbid stream pollution from oil wells and refineries, and to forbid the exportation of oil for one year. The purchase and sale by the Government of oil in times of unreasonable prices is also proposed.

A congressional commission of six members is receiving bids for the lease of the Muscle Shoals, Ala., nitrate and power project, and will report not later than April 26. Leases which they may recommend will be subject to approval or rejection by Congress.

To meet continued criticism of the Tariff Commission, aimed particularly at its consideration of duties under the flexible provision, the Senate appointed a committee of five members to investigate operation of the commission.

The House Interstate Commerce Commission reported on its investigation of combinations in foreign countries which restrict exports and fix prices on raw materials, including nitrates and potash. The committee recommends investigation of potash deposits in this country with the view to their development.

Silver Purchase

S. 756. Introduced by Mr. Pittman (Dem., Nev.). Reported by the Committee on Banking. This bill directs the Treasury Department to purchase 14,000,000 ounces of silver, at $1 per ounce, to complete purchases under the Pittman Act of 1918. The report was made by Senator Phipps, Republican, Colorado, who points out that additional purchases are to replace Pittman silver which was used for subsidiary coinage.

A minority report from the committee was made by Senators Glass (Va.), Tyson (Tenn.), Bratton (N. Mex.), Stephens (Miss.), Mayfield (Tex.), and Edwards (N. J.), Democrats, against the bill. These Senators take the position that the silver industry already received a bonus of $58,169,950 on previous purchases, because of the difference between the world market price of silver and the $1 per ounce fixed by the law, and would receive under this bill an additional $5,000,000. The report supports the Treasury Department in opposition to this measure. Senator Glass was chairman of the House Banking Committee when the original Pittman Silver Act was passed, and was Secretary of the Treasury during part of the time silver was purchased under that act.

War Minerals

S. 3188. Introduced by Mr. Pepper (Rep., Pa.). Referred to the Committee on Mines and Mining. This bill amends the war minerals relief act by permitting war mineral claimants to appeal from the Interior Department to the Court of Claims.

H. R. 9796. Introduced by Mr. Free (Rep., Calif.). Referred to the Committee on Mines and Mining. This is similar to the foregoing.

H. R. 7895. Introduced by Mr. Strong (Rep., Kans.). Referred to the Committee on Banking. This bill proposes to stabilize the price level of commodities and stability in value of money through the Federal Reserve Board. The bill says that stable money is the ideal gold standard and that it should be the standard of prices.

H. R. 10170. Introduced by Mr. Porter (Rep., Pa.). Referred to the Committee on Coinage. This bill proposes to coin 1,000,000 50-cent pieces in commemoration of the birth of Stephen C. Foster, musical composer.

Mine Exposition

H. R. 9629. Introduced by Mr. Fairchild (Rep., N. Y.). Referred to the Committee on Expositions. This bill proposes an exposition of mine and other products in New York in 1932 in celebration of the two hundredth anniversary of the birth of George Washington.

H. R. 9834. Introduced by Mr. Bloom (Dem., N. Y.). Referred to the Committee on Expositions. This bill proposes a similar exposition, to be held at Brooklyn. It proposes that the buildings for the exposition shall be of iron, steel, and glass. It proposes to coin 1,000,000 50-cent pieces and 200,000 $2.50 pieces.

S. 3340. Introduced by Mr. Fess (Rep., Ohio). Referred to the Committee on Interstate Commerce. This bill would forbid transportation in interstate commerce of articles mined or manufactured by convict labor unless they are marked to show production by such labor.

S. 3601. Introduced by Mr. Walsh (Dem., Mont.). Referred to the Committee on Labor. This is similar to the foregoing.

H. R. 9395. Introduced by Mr. Bacon (Rep., N. Y.). Referred to the Committee on Insular Affairs. This bill proposes a form of government for the Virgin Islands, and specifies that said government shall have control over the mines therein, for administration for the benefit of the people.

H. R. 10276. Introduced by Mr. Kiess (Rep., Pa.). Referred to the Committee on Insular Affairs. This is similar to the foregoing.

S. 3228. Introduced by Mr. Willis (Rep., Ohio). Referred to the Committee on Territories. This is similar to the foregoing.

Gilsonite Lands

H. R. 5385. Introduced by Mr. Colton (Rep., Utah). Reported by the Committee on Public Lands. This bill provides for prospecting permits and leases for asphalt, gilsonite, elaterite, and other like substances on the public domain, including the former Uncompahgre Indian Reservation in Utah. The permits and leases would be for two years for 640 acres of land. Leases would be for 320 acres on known deposits, at a royalty of 50 cents per ton and an advance rental of 50 cents per acre for each year, the leases to run for 20 years.

S. 3416. Introduced by Mr. King (Dem., Utah), by request. Referred to the Com-

IMPORTANT BILLS REVIEWED IN THIS ISSUE

MINING—

S. 756: Pittman (Dem., Nev.). Silver Purchase.
S. 3188: Pepper (Rep., Pa.). War Minerals Relief.
H. R. 9629: Fairchild (Rep., N. Y.). Mine Exposition.
H. R. 5385: Colton (Rep., Utah). Gilsonite Leases.
S. Res. 159: Cameron (Rep., Ariz.). Land Inquiry.
H. R. 5243: Sinnott (Rep., Oreg.). Potash Leases.
S. 1821: Sheppard (Dem., Tex.). Potash Investigations.
H. J. Res. 189: Frear (Rep., Wis.). Indian Oil.
S. 2461: Cameron (Rep., Ariz.). Oil Drilling.
H. J. Res. 188: Thomas (Dem., Okla.). Oil Leases.
S. Res. 151: Norris (Rep., Nebr.). Mexican Oil.
S. 3186: Ransdell (Dem., La.). Sulphur Leases.

COAL—

S. 3503: McMaster (Rep., S. Dak.). Government Sale.
S. 3530: Wheeler (Dem., Mont.). Federal Anthracite Corporation.
S. 3556: Copeland (Dem., N. Y.). Bureau of Coal Industry.

OIL—

H. R. 9570: Wilson (Dem., La.). Stream Pollution.
H. J. Res. 194: Howard (Dem., Nebr.). Export Embargo.
S. 3504: McMaster (Rep., S. Dak.). Government Sale.

TRANSPORTATION—

H. R. 9463: Parker (Rep., N. Y.). Railroad Labor Disputes.
S. 3466: Cummins (Rep., Iowa). Long and Short Haul.

INDUSTRIAL—

H. Con. Res. 4: Snell (Rep., N. Y.). Muscle Shoals Lease.
S. 3331: Johnson (Rep., Calif.). Colorado River.
H. R. 10092: Hastings (Dem., Okla.). Water Use.
S. Res. 162: Robinson (Dem., Ark.). Tariff Inquiry.
S. Res. 163: Dill (Dem., Wash.). Foreign Branches.
H. Res. 59: Tilson (Rep., Conn.). Raw Materials.
H. R. 1: Green (Rep., Iowa). Tax Law.
H. R. 10091: Hare (Dem., S. C.). Plant Closing.
S. 3474: King (Dem., Utah). Patent Use.

mittee on Public Lands. This is similar to the foregoing.

H. R. 9037. Introduced by Mr. Sinnott (Rep., Oreg.). Passed by the House. This bill validates certain land entries, including the mineral entry of John H. Haggett in the Portland, Oreg., district.

S. 3223. Introduced by Mr. Stanfield (Rep., Oreg.). Referred to the Committee on Public Lands. This is similar to the foregoing.

Land Inquiry

S. Res. 159. Introduced by Mr. Cameron (Rep., Ariz.). Passed by the Senate. This resolution authorizes the Committee on Public Lands to continue its investigation of the public domain, which has covered mineral lands, until March 4, 1927.

H. R. 9917. Introduced by Mr. Sinnott (Rep., Oreg.). Referred to the Committee on Public Lands. This bill, which provides for a revision of the boundary of the Yellowstone National Park in Montana, Wyoming, and Idaho, stipulates that the changes in the boundary shall not affect valid existing claims, locations, or entries under the mineral land laws.

S. 3427. Introduced by Mr. Stanfield (Rep., Oreg.). Referred to the Committee on Public Lands. This is similar to the foregoing.

Potash Development

H. R. 5243. Introduced by Mr. Sinnott (Rep., Oreg.). Reported by the Committee on Public Lands. This bill authorizes two-year prospecting permits for 2,560 acres of land for potash development, except on deposits near Searles Lake, California. If the permittee discovers potash he would be entitled to a lease at a royalty of 2 percent of the quantity or gross value of his output. Lands known to contain potash would be leased in similar tracts at a 2 percent royalty and an advance rental of 25 cents per acre for the first year; 50 cents for the second, third, fourth, and fifth years; and $1 per acre per year for the balance of the 20-year lease.

S. 1821. Introduced by Mr. Sheppard (Dem., Tex.). Reported by the Committee on Agriculture. This measure proposes an appropriation of $550,000 annually for the next five years for investigations by the Geological Survey and Agricultural Department as to the location and extent of potash deposits in the United States and of new and improved methods for their recovery.

H. R. 7372. Introduced by Mr. Sinnott (Rep., Oreg.). Reported by the Public Lands Committee. This bill amends the leasing law by limiting leases or permits to 2,560 acres.

Mineral Rights

S. 3498. Introduced by Mr. Phipps (Rep., Colo.). Referred to the Committee on Agriculture. This bill creates grazing districts on public lands. It allows the use of timber, coal, and other deposits by bona fide settlers, miners, and prospectors for minerals, on these grazing districts for mining and prospecting. The bill does not restrict the use of water on public lands in such districts for mining purposes, nor would it prevent prospecting, locating, developing, entering, or patenting their mineral resources.

S. 3567. Introduced by Mr. Smoot (Rep., Utah). Referred to the Committee on Public Lands. This bill seeks to give title to land grants to the states by limiting the time in which the mineral character of the land may be claimed as an objection to such grants.

H. R. 10360. Introduced by Mr. Colton (Rep., Utah). Referred to the Committee on Public Lands. This is similar to the foregoing.

H. R. 10357. Introduced by Mr. Davenport (Rep., N. Y.). Referred to the Committee on the District of Columbia. This bill names a large number of persons, including Harry F. Daniel, and Simon Guggenheim and Van H. Manning, former Director of the Bureau of Mines and now connected with the American Petroleum Institute, as incorporators of the National Institute of Social Sciences.

H. R. 7752. Passed by the House. This bill authorizes mining leases on Indian agency and school lands.

H. J. Res. 189. Introduced by Mr. Frear (Rep., Wis.). Referred to the Committee

on Rules. This resolution, which calls for an investigation by a congressional committee of 10 members, equally divided between the House and Senate, of the Indian Bureau, of the Interior Department, charges mismanagement of Indian affairs. It alleges that the Commissioner of Indian Affairs has advocated laws that will require the Indians to give "unjust oil leases reaching many millions of dollars and unwarranted favors to oil producers and speculators."

H. R. 10053. Introduced by Mr. Frear (Rep., Wis.). Referred to the Committee on Indian Affairs. This bill amends the leasing law in its application to unallotted Indian lands.

S. 3431. Introduced by Mr. Cameron (Rep., Ariz.). Referred to the Committee on Indian Affairs. This is similar to the foregoing.

Oil Lands

S. 2461. Passed by the Senate and reported by the House Committee on Public Lands. This bill authorizes an extension of two years to oil and gas permittees in cases where they have been unable to perform drilling operations as required by existing law.

H. J. Res. 188. Introduced by Mr. Thomas (Dem., Okla.). Referred to the Committee on Public Lands. This resolution proposes to give preference in permits or leases in the Red River region to those who had previously operated the lands but who were denied rights, on the ground that their operations were not continued.

S. J. Res. 64. Introduced by Mr. Stanfield (Rep., Oreg.). Referred to the Committee on Public Lands. This resolution gives a preference right to a lease for 360 acres of land to persons who attempted to make placer locations in the Red River region under the mining laws, which were invalidated by court decisions.

S. J. Res. 73. Introduced by Mr. Harreld (Rep., Okla.), by request. Referred to the Committee on Public Lands. This bill would give a preference right to applicants for permits or leases in the Red River oil region who had claimed this land but were ruled out by a court decision.

Mexican Lands

S. Res. 151. Introduced by Mr. Norris (Rep., Nebr.). Passed by the Senate. This resolution calls on the State Department for information as to the conflict of constitutional provisions of Mexico with rights of Americans acquired in oil lands in that country prior to their adoption.

S. Res. 167. Introduced by Mr. King (Dem., Utah). Referred to the Committee on Foreign Relations. This resolution proposes to request the State Department for correspondence covering protests of Americans against destruction of their property in Mexico.

H. Res. 140. Introduced by Mr. Fairchild (Rep., N. Y.). Referred to the Committee on Foreign Affairs. This resolution requests information from the State Department as to the confiscation or interference with property rights of Americans in Mexico.

Sulphur Leases

S. 3186. Introduced by Mr. Ransdell (Dem., La.). Referred to the Committee on Public Lands. This bill authorizes two-year prospecting permits for sulphur on 640 acres of land, except in San Bernardino County, Calif. If the permittee discovers sulphur he could obtain a lease at a royalty of 5 percent of the quantity or gross value of the output. Leases for a like amount of land could be made on lands known to contain sulphur at an advance rental of 50 cents per acre per year.

H. R. 9725. Introduced by Mr. Lazaro (Dem., La.). Referred to the Committee on Public Lands. This is similar to the foregoing.

Mining Securities

S. 3532. Introduced by Mr. Capper (Rep., Kans.). Referred to the Committee on the District of Columbia. This bill proposes to regulate the sale of oil, gas, or mining securities in the District of Columbia under the District Commissioners.

H. R. 3858. Introduced by Mr. Hoch (Rep., Kans.). Reported by the Committee on Interstate Commerce. This bill proposes to put in the organic act of the Department of Commerce authority for the foreign commerce service of that department which heretofore has been conducted under annual appropriations.

S. 3383. Introduced by Mr. Jones (Rep., Wash.). Referred to the Committee on Commerce. This is similar to the foregoing.

Coal Control

S. 3503. Introduced by Mr. McMaster (Rep., S. Dak.). Referred to the Committee on Interstate Commerce. This bill provides that when the President or Congress declares an emergency in the coal situation because of excessive retail prices, the President shall purchase coal at mines and ship and sell it at reasonable prices, through such agencies as he may create. This bill appropriates $1,000,000.

S. 3530. Introduced by Mr. Wheeler (Dem., Mont.). Referred to the Committee on Mines and Mining. This bill authorizes the creation of a Federal anthracite corporation of three persons from the anthracite-consuming states, and three from nine persons nominated by the miners' union, these six to select a seventh member. They would receive $10,000 yearly salary. This corporation would be organized in case of an emergency. The bill authorizes a capital stock of $600,000,000 for the corporation, to be subscribed by the Government, for which the bill makes an appropriation. The corporation could make contracts, acquire and dispose of property, and produce and market anthracite. The corporation would have its principal office at some place in the anthracite-producing region and branch offices at other places. The corporation would make an annual report to Congress. During the emergency the President would be authorized to take over for the corporation any or all anthracite coal properties, including mines, coal land reserves, generating stations, and storage yards. Those from whom their property may be taken would be paid just compensation, fixed by the President, subject to suit in the courts for additional compensation if not considered satisfactory. In fixing the compensation the bill says the President "shall be guided by the prudent investment in the property." The corporation would produce and market anthracite at fair and reasonable prices. The income of the corporation, after paying operating expenses and principal and interest on its stock, would be used in constructing additional collieries or generating plants or for the lease of additional timber lands or water rights for the generation of power. The corporation would have control over the fixing of wages. It is provided that the corporation and the miners' union shall give 60 days notice before a wage agreement expires of a desire to make changes therein. Within 10 days of such notice the corporation and union would meet to consider a new wage, in which discussion consideration would be given to reports of the Departments of Commerce and Labor. These departments are directed to investigate and report annually to Congress on production and sales efficiency of the corporation and on wages, individual output, and working and safety conditions, for use in adjustment of wage contracts and price levels in the anthracite industry. The bill appropriates $500,000 for expenses of the corporation.

Coal Bureau

S. 3556. Introduced by Mr. Copeland (Dem., N. Y.). Referred to the Committee on Labor. This bill creates a bureau of coal industry to report on conditions of production, distribution, storage, costs, prices, profits, marketing, wages, working conditions, intercorporate relations, trade and labor conditions, practices, ownership, royalties, and all other factors affecting the operation of the coal industry, for consideration in determination of a sound public policy regarding the industry. If employers and employes in the industry can not themselves settle disputes regarding wages and working conditions, the President is authorized to employ officers or agencies to mediate such disputes and to induce them to sub-

mit the controversy to arbitration. If this procedure does not end the controversy, the President could appoint an emergency coal board, which would investigate and report to him in 30 days. If this board did not settle the controversy, the President would be authorized to take over and operate, directly or by lease, any and all properties for production and distribution of coal at reasonable prices, paying the owners just compensation, and fixing reasonable compensation for performance of services in the acquisition or operation of the properties.

H. R. 10315. Introduced by Mr. Jacobstein (Dem., N. Y.). Referred to the Committee on Interstate Commerce. This is similar to the foregoing.

Industrial Peace

H. J. Res. 178. Introduced by Mr. Browning (Dem., Tenn.). Referred to the Committee on Rules. This resolution creates an industrial relations commission, consisting of three Senators, three Representatives, and three persons appointed by the President, one representing organized labor, one representing employers, and one representing farm organizations. They would be paid $10 a day and expenses, could meet anywhere in the United States, and could compel the attendance of witnesses. The commission would report recommendations within a year looking to the discovery of "laws of industrial peace." It would investigate labor relations in the principal industries of the country. The bill appropriates $25,000.

Naval Coal

H. R. 10003. Introduced by Mr. Butler (Rep., Pa.). Referred to the Committee on Naval Affairs. This bill appropriates $19,710,000 to convert six coal-burning battleships into oil burners.

H. R. 9690. Introduced by Mr. Butler (Rep., Pa.). Reported by the Committee on Naval Affairs. This bill appropriates $85,078,750 for five-year construction of naval aircraft, including $300,000 for an experimental metal-clad airship.

H. R. 9881. Introduced by Mr. Magee (Rep., Pa.). Referred to the Committee on Naval Affairs. This bill authorizes the abandonment of the coal depot at Frenchmans Bay, Me.

H. R. 10312. Introduced by Mr. Magee (Rep., Pa.). Reported by the Committee on Naval Affairs. This is similar to the foregoing.

Oil Pollution

H. R. 9570. Introduced by Mr. Wilson (Dem., La.). Referred to the Committee on Rivers and Harbors. This bill authorizes the Secretaries of War, Interior, and Commerce to fix regulations to prevent the pollution by oil of navigable rivers in the United States from oil wells, terminals, refineries, tanks, or storage places.

Oil Exports

H. J. Res. 194. Introduced by Mr. Howard (Dem., Nebr.). Referred to the Committee on Interstate Commerce. This bill would forbid the exportation from the United States for one year of crude oil and gasoline, under supervision of the Treasury Department. The resolution says the production and distribution of gasoline is controlled by a combination and that consumers are compelled to pay exorbitant prices. It also says the exportation of gasoline is impairing the domestic supply to the danger point, threatening further increase in gasoline prices.

Oil Sale

S. 3504. Introduced by Mr. McMaster (Rep., S. Dak.). Referred to the Committee on Interstate Commerce. This bill authorizes the President to purchase and sell at retail at reasonable prices gasoline, fuel oils, kerosene, and lubricants, when retailers charge excessive prices. The President could employ or create new Government agencies to carry out this law, and could take by purchase or condemnation gasoline stations and other retailing agencies. The bill appropriates $5,000,000.

H. R. 252. Introduced by Mr. Temple (Rep., Pa.). Reported by the Committee on Buildings and Grounds. This bill authorizes the Government to accept title to land for a post office at Donora, Pa., with a reservation to the owner of the natural gas and oil underneath. It is said that all lands in that city are subject to such mineral reservation.

Railroad Labor

H. R. 9463. Introduced by Mr. Parker (Rep., N. Y.). Passed by the House. This bill provides regional and other boards to settle railroad labor disputes, and abolishes the Railroad Labor Board.

S. 2306. Introduced by Mr. Watson (Rep., Ind.). Reported by the Committee on Interstate Commerce. This is similar to the foregoing. It appropriates $300,000.

S. 3466. Introduced by Mr. Cummins (Rep., Iowa). Referred to the Committee on Interstate Commerce. This bill is designed to prevent railroads from charging more for a short haul than for a long haul.

H. R. 6573. Passed by the House. This extends the time within which the Alaska Anthracite Railroad shall complete its lines in Alaska.

S. 2808. Introduced by Mr. Smith (Dem., S. C.). Reported by the Committee on Interstate Commerce. This bill provides for 13 interstate commerce commissioners, to be appointed from districts of the country as follows: New England, one; Middle Atlantic, two; Lakes, three; South Atlantic, two; Gulf, two; Mountain, two; Pacific, one.

H. R. 9723. Introduced by Mr. Brand (Dem., Ga.). Referred to the Committee on Interstate Commerce. This bill proposes to repeal laws which deprive the states of the right to fix intrastate rates.

S. 2320. Reported by the Committee on Interstate Commerce. This bill proposes to safeguard the distribution and sale of dangerous caustic or corrosive acids.

S. 3286. Introduced by Mr. Mayfield (Dem., Tex.). Reported by the Committee on Interstate Commerce. This bill authorizes reduced freight rates in case of earthquake, flood, fire, famine, drought, epidemic, pestilence, or other disaster.

Steel Cars

S. 3372. Introduced by Mr. Dale (Rep., Vt.). Referred to the Committee on Post Offices. This bill provides for steel cars in the Railway Postal Service.

H. R. 10388. Introduced by Mr. Browning (Dem., Tenn.). Referred to the Committee on Interstate Commerce. This bill confers jurisdiction over water transportation in the Interstate Commerce Commission.

Muscle Shoals

H. Con. Res. 4. Passed by Congress. This resolution authorized the appointment of a congressional commission to receive and report to Congress bids for lease for 50 years of the Muscle Shoals, Ala., nitrate and power project, reporting April 26. The commission appointed thereunder consists of Senators Deneen, Illinois, and Sackett, Kentucky, Republicans; and Heflin, Alabama, Democrat; Representatives Morin, Pennsylvania, and James, Michigan, Republicans; and Quin, Mississippi, Democrat.

S. J. Res. 68. Introduced by Mr. Smith (Dem., S. C.). This bill was introduced on two occasions and once offered but rejected as an amendment to the Muscle Shoals resolution. One of the resolutions proposed to appropriate $5,000,000 and the other to appropriate $20,000,000 for operation of the plant by the Department of Agriculture, under a Government corporation.

Power Development

S. 3331. Introduced by Mr. Johnson (Rep., Calif.). Referred to the Committee on Irrigation. This bill proposes to develop power on the Colorado River at Black or Boulder Canyon at a cost of $125,000,000, under a 50-year 4 percent bond issue.

H. R. 9826. Introduced by Mr. Swing (Rep., Calif.). Referred to the Committee on Irrigation. This is similar to the foregoing.

S. 3414. Introduced by Mr. Cameron (Rep., Ariz.), by request. Referred to the Irrigation Committee. This bill provides for electrical power development at Glen and Bridge Canyon, on the Colorado River, at a cost of $300,000,000.

H. R. 10092. Introduced by Mr. Hastings (Dem., Okla.). Referred to the

Committee on Flood Control. This bill authorizes interstate compacts between any of the states for control of floods, conservation of flood waters, and the application of such waters to beneficial uses.

H. J. Res. 193. Introduced by Mr. Gorman (Rep., Ill.). Referred to the Committee on Rules. This resolution proposes an investigation of the right of Chicago to divert water from Lake Michigan by its sanitary canal.

H. R. 9798. Introduced by Mr. Browne (Rep., Wis.). Referred to the Committee on Indian Affairs. This bill appropriates $600,000 for hydroelectric power development on rivers in the Menominee Reservation, Wisconsin.

S. 3342. Introduced by Mr. Cameron (Rep., Ariz.). Referred to the Committee on Irrigation. This bill proposes to give clear title to rights of way for the Verde River irrigation and power district in Arizona.

Tariff Inquiry

S. Res. 162. Introduced by Mr. Robinson (Dem., Ark.). Passed by the Senate. Under this resolution the following Senators are investigating the Tariff Commission and its administration of the flexible provision of the tariff law under which duties may be increased or decreased by 50 percent: Wadsworth, New York, and Reed, Pennsylvania, Republicans; La Follette, Wisconsin, Progressive Republican; Robinson, and Bruce, Maryland, Democrats. It will cover the proceedings of the commission in determining the difference in cost of production in the United States and in competing countries and the method of ascertaining which country constitutes the principal competing country. It will also investigate whether the commission has been influenced in its actions by Government officials or others.

S. 3447. Introduced by Mr. Robinson (Dem., Ark.). Referred to the Finance Committee. This bill proposes to reduce the membership of the Tariff Commission from six to four members, and would disqualify members of the commission from acting in a case which would benefit them.

S. 163. Introduced by Mr. Dill (Dem., Wash.). This resolution requests the Department of Commerce to investigate and report on the number of American companies which have established branch offices in foreign countries during the past five years. The resolution says it has been charged that the purpose of the tariff is to enable those in the United States who benefit by it to charge the foreign price, plus the tariff duty. It is also said that as the cost of production is less in foreign countries, American manufacturers are establishing branches in foreign countries to reduce costs.

S. Res. 165. Introduced by Mr. Smoot (Rep., Utah). Passed by the Senate. This resolution, which has been complied with, called on the Tariff Commission for the minutes of its proceedings since it was organized, September 19, 1922, to January 26, 1926, which have been published by the Senate.

Raw Materials

H. Res. 59. Reported on by the Committee on Interstate Commerce. This report, made by Representative Newton, Republican, Minnesota, is based on an investigation by the committee of foreign government control of production and exportation of essential raw materials and its effect on American commerce. He says Chile controls either the production or exportation of nitrates, which materially affects the price. The same condition exists in regard to potash in Germany and France. Chile produces all the world's natural nitrates, but consumes only a small part. The United States consumes 50 to 75 percent of nitrate production. The Chilean nitrate control dates back to 1885. As showing that the tariff is not a factor in the situation, the report says 98 percent of our imports from Chile are admitted free. The committee declares that the price of potash is exorbitant. The Chile nitrate producers' association covers all producers except two American companies. The committee recommends that the Bureau of Mines or Geological Survey explore potash deposits in Texas, Utah, and other states, as it believes there is opportunity for development of potash resources in the United States. It opposes aid or subsidy to Americans in development of alternate supplies of raw materials, as it would be an intrusion of Government into production. The committee does not approve at this time combinations of American purchasers to buy on a cooperative basis, as such action is not urgently demanded by the trades concerned.

S. 3368. Introduced by Mr. Goff (Rep., W. Va.). Referred to the Judiciary Committee. This bill proposes to forbid the loan by Americans to foreigners who restrain competition or monopolize trade in any commodity imported into the United States.

Tax Law

H. R. 1. Enacted into law. This is the revised tax bill, effective on 1925 income.

Forest Lands

H. R. 10006. Introduced by Mr. Peavy (Rep., Wis.). Referred to the Committee on Agriculture. This bill appropriates $2,000,000 yearly for 10 years for purchase and distribution, free, by the Department of Agriculture of explosives to settlers for clearing and reclaiming cut-over forest land areas.

S. 3405. Introduced by Mr. Fess (Rep., Ohio). Referred to the Committee on Agriculture. This bill appropriates $30,000 for the establishment of a forest experiment station in the Ohio and Mississippi Valleys.

Antitrust

S. Res. 153. Introduced by Mr. King (Dem., Utah). Passed by the Senate. This called on the Department of Justice for a report as to activities under the antitrust law, including the number of decrees obtained in the courts, properties seized, and convictions of persons for its violation. The Department made a report on this subject.

H. R. 10091. Introduced by Mr. Hare (Dem., S. C.). Referred to the Committee on Interstate Commerce. This bill would require manufacturers employing more than 100 persons to notify the Federal Trade Commission of their intention to suspend or close their plants for more than 30 days. If the commission believes the closing or suspension by two or more manufacturers is the result of an agreement or conspiracy to restrain commerce it may prevent such action.

H. J. Res. 184. Introduced by Mr. Newton (Rep., Mo.). Referred to the Committee on Interstate Commerce. This bill provides for the return of alien enemy property seized during the war, and appropriates $180,000,000 for settlement of claims determined by the American-German Claims Commission.

H. R. 9498. Introduced by Mr. Graham (Rep., Pa.), by request. Referred to the Committee on Judiciary. This bill provides compensation for maritime employes who are injured or killed.

Patent Use

S. 3474. Introduced by Mr. King (Dem., Utah). Referred to the Committee on Patents. This bill provides for compulsory license for the use of unused patents.

H. R. 10207. Introduced by Mr. Wefald (F. L., Minn.). Referred to the Committee on Patents. This bill would assist inventors in perpetuating evidence of conception of their inventions.

H. R. 10208. Introduced by Mr. Wefald (F. L., Minn.). Referred to the Committee on Patents. This bill amends the law covering procedure in the Patent Office.

Claim Bills

S. 3404. Introduced by Mr. Bruce (Dem., Md.). Referred to the Committee on Claims. This bill proposes to pay $583 to the Baltimore Copper Smelting & Rolling Co. for damage to one of its trucks by collision of an Army truck in Baltimore, September 28, 1925.

H. R. 9952. Introduced by Mr. Taylor (Rep., N. J.). Referred to the Committee on Claims. This bill proposes to pay $7,192 to the Western Electric Co. under a contract with the War Department in 1920.

H. R. 9953. Introduced by Mr. Taylor (Rep., N. J.). Referred to the Committee on Claims. This bill proposes to pay $2,319 to the Western Electric Co. under a Navy contract.

THE COST OF PRODUCING SHALE OIL

Oil Shale Offers One Source Of Replenishing The Steadily Decreasing Production Of Well Oil —Cost Of Producing Oil From Shale Vital Element To Industry's Future—An Analysis Of Factors Necessary To Successful Production

By VICTOR C. ALDERSON *

THE steady decrease in the production of well oil, the advancing price of crude and of gasoline, and the absence of new pools to maintain production have caused serious concern in the minds of persons interested in oil. Oil must be obtained. If not from wells, then from another source. The one source which holds enough raw material from which oil can be manufactured to meet the demand for centuries is oil shale. Consequently the cost of producing oil from shale is of vital import. An analysis of the entire problem seems to be fitting at the present time.

Some writers, without giving close attention to the practical features of the matter, have made interesting estimates which should be noted. Thus, Mark L. Requa, in "The Relations of Government to Industry" p. 117 makes the following statement: "The United States has, within its boundaries, enormous reserves of oil shale. Oil from this source will be available but at a price per barrel of probably not less than four to six dollars." Kirby Thomas, of New York, estimates that the cost of mining and treatment at $4.50 a ton, excluding depreciation or amortization of fixed capital charges. Gavin, Hill, and Perdew in the U. S. Bureau of Mines Miscellaneous Publication of 1919 in "Notes on the Oil Shale Industry," state that to mine, break, and deliver shale to retorts will cost from $1.50 to $2.50 a ton.

S. F. Shaw, writing in the Engineering and Mining Journal-Press of Dec. 12, 1925, has made some statements that should not be accepted without further analysis. On page 930 he states, "As a rule oil shale deposits are nearly horizontal and lie under overburden to such an extent that steam shovel methods can seldom be employed." This is correct as to the deposit at Elko, Nev., and only partly true in Colorado. At Casmalia, Calif., the N. T. U. Company is operating and mining oil shale by steam shovel methods. In Utah extensive exposures, as bluffs, give an excellent opportunity for steam shovel methods. At Green River, Wyo., J. Edson Himes has a bluff 200 feet high of oil shale which he proposes to mine by steam shovel methods. In Kentucky the bluffs of oil shale in the knob region extend over a distance of 200 miles. Every exposure can be mined by steam shovel methods. The same is true of exposures in Indiana and Ohio. In Colorado W. S. Skinner, of the Ventura-Colorado Oil Company, reports that diamond drilling on Brush Creek, 15 miles north of De Beque, showed 320 feet of commercial oil shale yielding from 15 to 68 gallons to the ton. The upper 220 feet yield an average of 42 gallons to the ton, all of which can be mined by open cut, steam shovel methods.

It must be evident from these facts that there is an enormous quantity of oil shale in the United States that can be mined on the open cut, steam shovel plan at a cost much below the prevailing cost of mining coal. However, on the basis of the cost of mining coal, $1.70, and the cost of retorting, 36 percent of the cost of mining, as in Scotland, Mr. Shaw estimates the cost of producing shale oil as follows (p. 930):

Mining per ton	$1.70
Retorting per ton	.60
Refining per barrel	.50
Interest on investment	.66
Depreciation—20 years	.55
	$4.01

Although the last three items are subject to controversy yet the first two are sufficient for investigation in order to get an unbiased view of the problem.

UNDERGROUND MINING

The deposit at Elko is five feet thick, dips at an angle of 25 degrees, and represents a condition similar to coal mining. R. M. Catlin and his superintendent have had nine years experience in mining and retorting oil shale, during which time they have built five commercial sized retorts each an improvement on the preceding one. Of the work Superintendent Sheeler says, "Costs of mining, retorting, and refining showed that on large scale operations the oil shale industry is a paying operation; that the high costs so much written about by people who had no way of confirming the figures were very misleading as all costs gained in such a manner represent merely a 'state of mind.' By making finished products and marketing them we obtained actual costs. Our operations have produced more than a million gallons of crude oil, a retort that is economical to operate, a mining cost that we believe is comparable to the cheap metal mining costs of the present day and refined products that will stand up and meet the competition of the highest grade petroleum products on the market today."

J. H. Ginet, President of the Monarch Oil Shale Company of De Beque, Colo., reports that on intermittent operations of his plant the costs, as taken from their books for actual operation, are as follows:

	Per Ton
Mining	$0.91
Crushing	0.06
Retorting	0.13
Depreciation and renewals	0.13
Overhead expenses	0.11
Total cost	$1.34

The mining follows general coal mining methods on a stratum of shale, the celebrated Mahogany, horizontal in position, 8 to 10 feet thick, yielding 64 gallons to the ton.

A method of mining by caving has been suggested by Fred Carroll and G. R. De Beque, both experienced mining engineers of Denver, in the Oil Bulletin of November, 1925, pp 1171-1175. The method is applied to a 50-foot seam of shale, yielding 36 gallons to the ton, underlaid by a poorer seam 34 feet thick yielding only 16 gallons a ton. In brief, all haulage ways, drifts, chute raises and caving pockets are confined to the lower stratum. The tops of the caving pockets extend up to the base of the high grade seam. After a careful analysis of all the expenses involved they conclude that by their method of mining oil shale can be delivered at the surface at a maximum cost of 60 cents a barrel of oil produced. The work of Messrs. Carroll and De Beque is worthy of serious consideration since both are high grade mining engineers, thoroughly familiar with mining conditions in Colorado.

The accountants, appointed by the Board of Trade in England to examine into the cost of operation of the oil shale industry in Scotland, reported that for the six months ending Sept. 30, 1925, the average cost of mining shale in all the mines of Scottish Oils, Ltd., was $1.81 and the average cost of retorting $0.85, making a total of $2.66 per ton of shale treated. The costs in Scotland have notably been high on account of technical and economic conditions and do not offer a fair comparison with costs in the United States.

OPEN CUT; STEAM SHOVEL METHOD

A study of the costs of open cut mining by the large copper companies

* Symes Bldg., Denver, Colo.

will throw light on the cost of mining oil shale by the same method. Stuart Croasdale, consulting engineer of Denver, has made a careful study of this question and has compiled the following data: At the Utah Copper Company the cost of mining and stripping, from 1910 to 1924, has varied from a minimum of $0.2441 a ton to a maximum of $0.537, or an average of 40 cents a ton for 15 years. Since the overburden averaged 106 feet the cost of mining alone was considerable less than these figures indicate.

At the Nevada Consolidated, for the years 1914 to 1916, the average cost of stripping was $0.3019 a ton and mining alone $0.1803. For the years 1920-21-22, steam shovel operations, exclusive of depreciation, and federal, state and local taxes but including all other overhead expenses, averaged as follows:

Drilling and blasting	$0.0545
Steam shovel	0.0285
Locomotive tramming	0.0691
General pit expenses	0.0266
Miscellaneous	0.0883
	$0.2679

The overburden averaged 102.5 feet.

At the Chino Copper Company for the years 1912 to 1916 the average cost of stripping was $0.2075 a ton; the cost of mining $0.1652. Such low costs for open cut mining are not confided, however, to this country. The Bwana M'Kubwa copper mine in the interior of Africa expects to have its plant in operation by March 1. A thousand tons of ore will be mined per day at an estimated cost of 40 cents a ton.

Louis Simpson, who is planning to open and operate the oil shale deposits in Albert County, New Brunswick, states that he expects to mine and deliver oil shale to the retorts for less than 50 cents a ton.

In Wyoming, J. Edson Himes, who is erecting a 250-ton retort at Green River, has gone deeply into the cost of mining on the open cut, steam shovel plan. After a careful analysis of costs of operation on a basis of 250 tons a day he estimates that the cost per ton for mining and delivery to the retorts will be 40 cents.

The Uintah Company owns 10,900 acres of oil shale land in Utah. The outcrops stand out prominently as cliffs, 150 to 200 feet high, with no overburden worth considering. R. V. Barkalow, president of the company, has made an exhaustive study of the cost of operation. After conferring with mining engineers, dredging companies, powder companies, chemical engineers, in fact after securing the best data obtainable for all phases of the work, he estimates the following cost of mining and retorting a ton of shale. The mining would be done on the open cut and steam shovel plan and the daily capacity of the plant 500 tons.

Drilling and blasting	$0.040
Steam shovelling	0.050
Tramming to retort	0.070
Crushing	0.055
Pit expense	0.015
Retorting	0.570
Repairs	0.050
Water	0.050
Storing	0.100
Administration	0.100
Interest	0.030
Miscellaneous	0.050
	$1.180

The shale treated will yield in the average a barrel of oil to a ton of shale. Hence $1.18 can reasonably be assumed to be the operating cost of a barrel of crude shale oil.

Tests made on the 40-ton plant of the N. T. U. Company at Sherman Cut, near Casmalia, Calif., also throw light upon the cost of producing shale oil. Two careful tests have been made; one by G. W. Wallace, engineer in charge, the other by Smith, Emery & Company, engineers of Los Angeles and San Francisco. The Wallace report is the average of four runs; 154.7 tons of shale were used; the oil yield per ton was 29.4 gallons; mining was done on the open cut, steam shovel plan.

The operating costs per ton were as follows:

Mining and crushing	$0.4326
Transportation	0.0102
Charging	0.0186
Operating	0.3600
Discharging	0.0444
Spent shale disposal	0.3342
Electric power, water, etc.	0.1750
Total cost per ton	$1.3750

The second test by Smith, Emery & Company gave the following:

Mining and crushing	$0.3214
Transportation	0.0085
Charging	0.0236
Operating	0.3896
Discharging	0.0095
Spent shale disposal	0.1809
Electric power, water, etc.	0.1536
Total cost per ton	$1.087

Since the yield of oil was 38.5 gallons per ton of shale the cost per barrel of 42 gallons was $1.18. This test was made under the direction of disinterested capable engineers and an auditor who checked the time of the men, the costs, and other details. In analyzing these figures several features should be carefully noted in order to get a proper appreciation of their meaning. The figures are for operation alone; no efforts are made to estimate overhead expense, taxes, interest, or depreciation. The low cost of mining results from the open cut system adopted; transportation is also low because the retort is close to the shale bed. Finally the figures can be depended upon, as far as they go, because of the high grade of the engineers and the accuracy of their work. These tests were made on a 40-ton plant. The company has started the erection of a 250-ton plant to cost complete $500,000 and is planning to add other units up to 1000 tons daily capacity. A contract has been made with the Associated Oil Company of California, for the delivery of 10,000 barrels of shale oil.

From this analysis and consideration of all the factors involved, it is reasonable to infer that an oil shale company, adequately financed and operating on the open cut plan, with a 500-ton daily through put, can manufacture shale oil at a cost of approximately $1.25 a barrel.

Karl C. Schuyler, of Denver, a man deeply interested in oil shale and a close student of the entire subject, recently testified before the Federal Oil Conservation Board in Washington as follows: "It is respectfully submitted that shale oil can be produced from this vast body of shale in projects of from 10 to 50,000 barrels per day at approximately $1.00 per barrel."

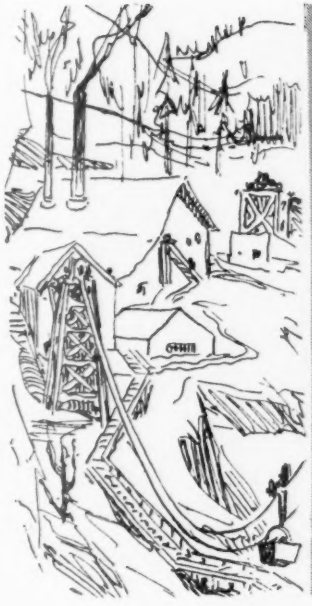
After a careful analysis of the entire situation, it is evident that the cost of producing shale oil is a variable amount which depends on still other variables; i. e., the size and position of the shale bed, the grade of the oil produced, the mining method adopted, the scale of operations, the cost of transportation from the mine to the treatment plant, the disposal of the spent shale, the nearness to railroad transportation, the cost of supplies, nearness to a market for the products, and the cost of labor. However, with the information available it seems to be a fair and justiable conclusion that if the oil shale industry is adequately financed and properly managed it can be made a valuable adjunct in helping to meet the constantly increasing demand for oil.

STANDARDIZING NON-METALLIC MINERAL PRODUCTS

(*Continued from page* 258)

it should be emphasized again that consuming industries are becoming more and more insistent upon high quality and uniformity in their raw materials. Far-sighted producers are exerting every effort to improve their materials and maintain uniformity. All other producers who wish to stay in business and make money must follow the trend of the times. They must, by some means, find a way to avail themselves of capable and efficient operating and managerial skill and of the latest improvements in machines and methods of production.

The legislatures of Florida and Virginia have rejected the proposed child labor amendment to the Constitution.



METALS

PRACTICAL OPERATING MEN'S DEPARTMENT

Practical Operating Problems of the Metal Mining Industry

THE MESABI IRON COMPANY ENTERPRISE

With Proper Beneficiation The Deposits Of Iron Ore In The Lake Superior District Will Assure Almost An Endless Life To The Steel Industry Of Central United States

By W. G. SWART*

THE Minnesota iron mining situation has recently had unusual attention and discussion, chiefly as to ore prices and reserves. So far as prices are concerned, the present low level seems to be largely due to the fact that increased war demands led to an overdevelopment in quick productive capacity, not yet overtaken. To this must be added the pressure to produce exerted by the leasing system, with its heavy annual minimum tonnage requirements, under which most Minnesota ore is mined; the approaching expiration of many old low royalty leases, royalties on which will be raised on renewal; and the taxation of reserves under the present State policy. All tend in a highly competitive business like iron mining to force out ore beyond the market demand, with the result that much is marketed below cost. Some light is thrown on the situation by the Government Statistics of Income for 1923 (the most recent year available). These statistics are for the entire country, but they are reasonably accurate for Minnesota. They show that of the 97 concerns engaged in producing iron ore throughout the country, 44 concerns made a profit of $8,183,000, 53 concerns sustained a loss of $5,665,000, 97 concerns made a balance of profit of $2,518,000.

W. G. Swart

The United States Geological Survey gives the iron ore production for that year as 69,811,472 gross tons, hence the profit was about 3.6 cents per ton. And since the prices received for iron ore in 1924 and 1925 have been from 80 cents to $1.40 per ton lower than in 1923 (at least on Minnesota ores) the losses must have been very heavy.

The Minnesota operator able to let his property stand idle since 1923 has lost money, but probably not as heavily as those who have operated. Some mines have long-term contracts and must produce regardless of price. Others find operating losses less than those resulting from interest charges, minimum royalty payments and taxes on reserves, when idle. But as a whole the industry is at present deeply smeared with red ink.

So far as ore reserves are concerned, Minnesota should properly be discussed only as a part of the Lake Superior region, yet with the Mesabi Range producing 65 percent of the entire Lake Superior output, it is manifest that its position is a commanding one, its future vital to the steel industry, and its troubles sure to be much the same as those of the other Ranges. That this latter is true is indicated, for example, by the fact that one of the first things done by Dr. W. O. Hotchkiss, after resigning as State Geologist of Wisconsin and becoming President of the Michigan College of Mines, was to call a conference of iron ore producers. This call read in part as follows:

"But most vital of all to the industry and also most important as a public problem, is the fact that we can foresee definitely that in a relatively short term of years the reserves of merchantable ore will be seriously diminished. This means that the Michigan iron mining industry must do one of two things. It must eventually gradually disappear, or it must prepare itself to use materials not now merchantable."

This applies to Minnesota perhaps more urgently than to Michigan, and particularly to the Mesabi Range, for here the geology and development methods are such that there is less likelihood of discovery of further important merchantable ore bodies. Much additional ore will be found on the Mesabi Range, both as new, and extensions of older, ore bodies, but not in 30,000,000-ton lots, and 30,000,000 tons is but one year's output. Prospecting is pretty

* Vice-President and Gen. Mgr. Mesabi Iron Co., Babbitt, Minn.

much at a standstill in Minnesota anyway, and almost wholly so on the Mesabi Range. No one wants to put unwanted ore on the tax lists under present laws. But even when resumed, Mesabi ore reserves of present standard grade can not be enormously increased.

The Minnesota Tax Commission gives the known Mesabi Range ore reserves in the ground as of May 1, 1925, at 1,253,442,107 tons. This is unquestionably a low figure, but it includes for the first time about 50,000,000 tons of so-called "low grade non-merchantable material" supposedly amenable to some sort of beneficiation but by no means so demonstrated.

Before the war the consumption of Lake Superior ore averaged to double about every 10 years. This rate cannot be expected to continue. It is pretty generally assumed that the present average normal demand for Lake Superior ore is around 50,000,000 tons per year. The following table shows the production for the past 10 years:

Year	Total Lake Superior Gross Tons	Mesabi Range Gross Tons	Percent Mesabi Range of Total
1916	66,658,466	42,525,612	63.8
1917	64,437,003	41,445,211	64.3
1918	62,836,172	40,396,711	64.3
1919	48,546,651	31,997,699	65.9
1920	60,411,572	37,149,277	61.5
1921	22,798,349	16,350,696	71.7
1922	43,990,096	28,055,394	63.8
1923	60,780,003	41,814,463	68.8
1924	43,895,110	29,141,665	66.4
1925	55,000,000*	36,000,000*	65.5
Total	529,353,422	344,876,728	....
Average	52,935,342	34,487,673	65.2

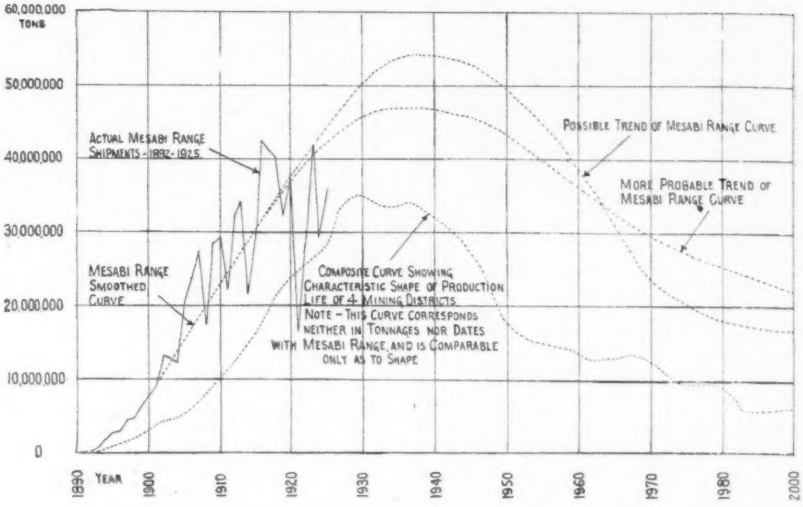
* Estimated. Totals, including all rail shipments, not yet available.

Some increase in consumption may be assumed as certain even though one may not wholly agree with Mr. Schwab's recent prediction that steel production in the United States will soon double. It is not improbable, and is anticipated by some well-posted steel men that the demand on Lake Superior for ore may rise from the present 50,000,000 tons to perhaps 75,000,000 tons annually, of which the Mesabi Range might be called on for 54,000,000 tons, assuming its normal percentage to be maintained, although the probabilities seem to be against any long continued shipments at any such rates.

Simply dividing the total reserves by the yearly output shows then a life for the Mesabi Range of from 23 to 34 years, depending on the divider's optimism as to both dividend and divisor. The Mesabi Range has already had a shipping life of 34 years, during which time more than 700,000,000 tons have been mined.

But there are most important factors, other than mathematical, affecting this situation. The life of the Range will be increased by discoveries of new ore, by extension of older ore bodies, by the use of lower grades on the furnace burden, by changing mining methods, by better prices permitting higher cost ore to come out, and by new beneficiating processes.

COMPARISON OF LIFE CURVES—MESABI RANGE WITH OTHER MINING DISTRICTS HAVING SIMILAR CHARACTERISTICS. BASED ON KNOWN RESERVES AND PROCESSES.



On the other hand this life, as a practical matter, based on ability to continue to supply all furnace requirements, will be shortened or modified by such considerations as these:

(1) Some operators have 40 to 50 years supply under control, others have 10 years, and others little or none. Selling and trading of ores have been common enough in the past, but when essential reserves begin to be drained it cannot be expected to continue. Those who have will be forced to keep.

(2) The reserves are not balanced as to furnace requirements. There is an excess of some grades and qualities and a deficiency in others. On this basis trading might continue a long time, and probably will, without however greatly affecting the inequalities pointed out in the preceding paragraph.

(3) Physical conditions in the mines themselves preclude the possibility that an annual output of 36,000,000 to 54,000,000 tons can be maintained up to the last years of any assumed life period. Rather must the extraction curve take the usual form for mining districts containing many similar mines; rising rather steeply to a long rounded peak, then falling more gradually in a long slope of lowering output. No mining district ever had its heyday of maximum production in its old age.

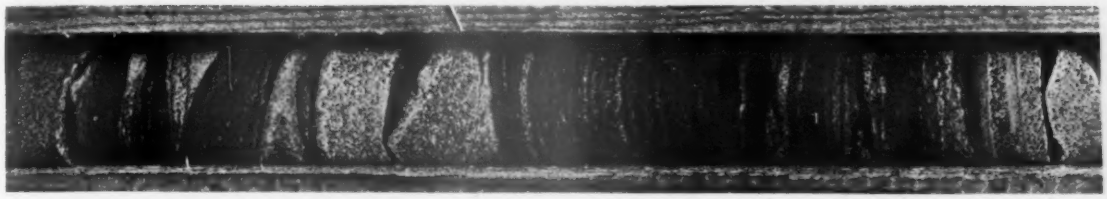
A comparison of such curves, as shown by the accompanying graph, keeping in mind the peculiarities of the case, shows that the Mesabi Range should be well toward the top of its annual productive capacity between 1934 and 1938. There are plenty of possible causes affecting these dates, but in the final analysis there is about so much merchantable ore to come out at a rate lying between reasonably fixed limits, and so far the extraction curve is normal.

Two things are important in considering this extraction or output curve. The first is that the early or rising portion represents response to demand, but when it begins to fall in the later years it will not represent slackening in demand (for as far as anyone can foresee there will be no permanent slackening of steel manufacture in this country) but rather inability to respond. The second is that while the Tax Commission figures show that more than two-thirds of the ore reserves on the Mesabi Range are owned or controlled by one company, this same company's shipments each year from that Range average only a little over one-half the total. The effect of such a situation on any estimate of total life is naturally considerable. On two-thirds of the ore there is indicated a controlled longer life than the average. The other third, supplying half the annual demand, must then show much shorter life, and is also subject to the vicissitudes of varied ownership.

Except for the possibility of new steelmaking processes being developed, perhaps the factor most likely to affect this Mesabi Range situation is the beneficiation of its ores. There are already 18 washing plants in operation, showing the following production:

Year	Total Ore Production	Washed Ore Production	Percent of Total
1923	41,814,463	7,362,430	17.6
1924	29,141,665	4,852,828	16.7
1925	36,000,000	6,000,000	16.7

These wash ores are included in the



Section of diamond drill core from East Mesabi showing typical occurrence of magnetite and quartzite in bands

reserve tonnage estimates given above. The jigging of Mesabi low grade ores has already begun, and is sure to be widely extended. Its effect on the life of the Range cannot yet be estimated.

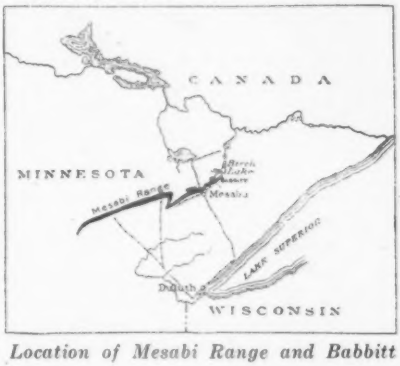
Like all other mining districts where choice was at all possible, the best and cheapest ores were attacked first. In 1902 the average analysis of all Mesabi shipments was 56.07 percent natural iron and 4.35 percent silica. In 1922 it was 51.99 percent iron and 7.92 percent silica. The iron is not likely to go below 50 percent for a long time, but silica is a present and increasing trouble in Mesabi ores as a whole. Washing and jigging are not a complete cure by any means, nor do the concentration methods, such as tabling or flotation used on lead, copper and zinc ores, seem likely to find much place.

The blast furnaces are accustomed to an average iron analysis of about 52 percent in their ores, and, everything considered, this may probably be considered economically sound, although when higher grade ores are obtainable at corresponding unit prices they show better returns, because of increased pig iron output per unit of furnace time and investment. But aside from this, under present prices of fuel, stone and labor, any additional silica, above the minimum for slag-fall requirement, shows rather prominently in the blast furnace cost sheet. Calculations by various furnace operators show that to smelt such additional silica costs from 13 to 20 cents per unit.

The above has been given as a background for a picture of the Mesabi Iron Company operations, which have attracted unusual attention and interest, principally, perhaps, because of the tonnage possibilities.

At the inception of the enterprise it was believed by Mr. D. C. Jackling and his associates that the organization, mining, and metallurgical methods proven so successful on the porphyry coppers could be applied successfully to low grade iron ores.

Among the factors favorable to the undertaking were the location of the property, on the main iron ore highway of the country, with adequate transportation of long standing; the terms on which the property was acquired; the size and uniformity of the deposits; the ease of attack; the absence of necessity for expensive stripping, pumping and mine development; the comparative simplicity of the metallurgy; the possibility of marketing valuable by-products, and the high grade, desirable structure and uniform quality of the resulting iron ore product. To this may be added the ownership of all surrounding lands, so that the levying and spending of the local taxes, so disastrous elsewhere on the Range, might be controlled. Only about 10 percent to 12 percent of the



Location of Mesabi Range and Babbitt

total mine tax in Minnesota is a State tax, and this is assessed with equity by the Tax Commission, although the justice, wisdom and economic result of the tax laws under which it is done are open to criticism. It is the local tax that rests so heavily on Mesabi Range mining, and although the industry pays 95 percent of all taxes in its municipalities, the levying and expending of this money for the wonderful local improvements are almost wholly out of its control.

The two unknown quantities in the Mesabi Iron Company enterprise were the extra cost of handling the very hard tough taconite rock, and the trend of the ore market. The hard rock ghost has been laid, but the distressed spirit of an unhappy ore market still walks abroad. No producer is making any real profit, and most are suffering heavy losses, but it is a situation that will right itself in time.

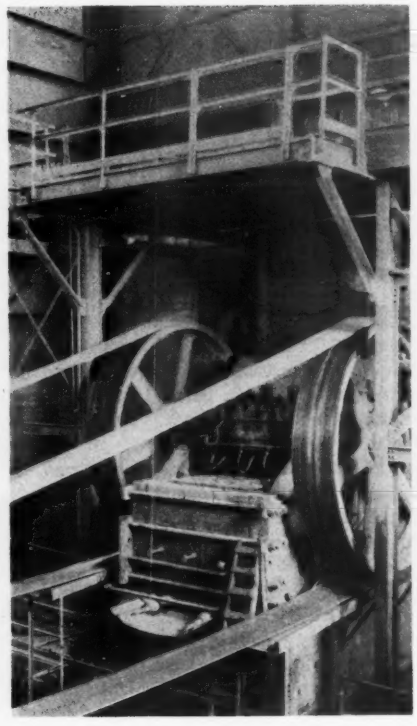
Mr. Jackling's belief in the possibilities of the enterprise has been confirmed by the results obtained at the plant constructed at Babbitt in 1920 and 1921, and operated during 1922, 1923 and part of 1924. This plant has been described several times in considerable detail in the technical press, and it is probably of more interest to the type of business man making up the American Mining Congress membership to discuss the results obtained and their meaning rather than to describe minute plant details. Still a general survey of the plant and process may not be out of place.

The Mesabi Iron Company operations are located at the extreme Eastern end of the Mesabi Range. The deposits here are very large, and differ from those of the Central and Western Mesabi in several respects: They are not deeply covered with glacial drift, much of the raw material lying exposed at the surface; they have not been softened, leached and irregularly concentrated or segregated into high grade bodies separated by low grade taconite like the deposits farther West, and the iron exists here as magnetite, whereas to the West it is hematite and limonite. The raw material at Babbitt is a hard flat-lying ferruginous chert known as taconite, and made up of alternating bands of magnetite and quartzite, uniform in character and grade over large areas, and containing numerous jointing and bedding planes.

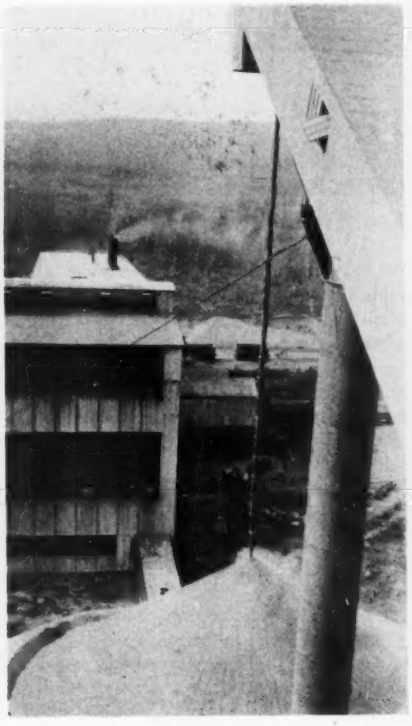
These characteristics and differences have determined both the methods of mining and of milling. So far as winning the raw material is concerned it is a quarry operation rather than a mine. Churn drills put down six inch holes to the depth of the quarry face, which is usually 35 to 40 feet, although faces 100 to 150 feet are possible. These holes are shot in groups with 40 percent and 60 percent dynamite. The broken taconite is then loaded by 100-ton steam shovels into heavy steel dump cars, which are hauled to the mill over about three miles of standard gauge track laid with 80 and 100 pound rail, the maximum grade being less than one percent against the load.

This raw material (taconite) constitutes the mill feed, and carries about 28 percent iron as magnetite.

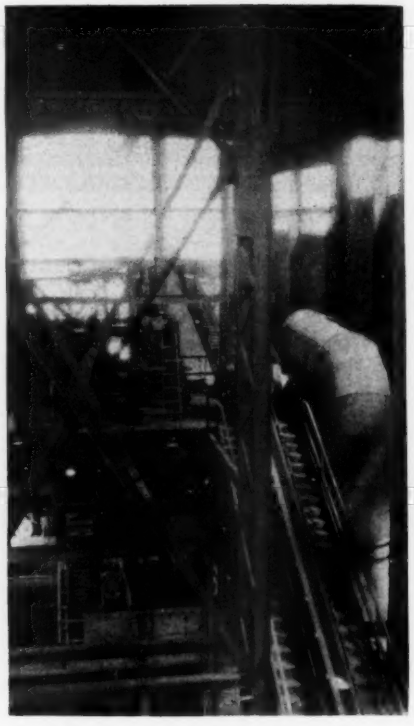
The loaded cars are dumped into a small pocket at the mill, from the bottom of which an 8-foot steel pan conveyor draws the taconite, delivering it as desired to the crushing plant. This plant is installed in a pit in the solid granite, about 100 feet deep by 50 feet square. The crushers are all of cast steel, made extra heavy for the severe service de-



48" by 72" primary jaw crusher



Cob storage pile



Sintering plant, Mesabi Iron Co.

manded by the hard and tough rock. They are as follows:

One 48 x 72-in. Jaw Crusher, breaking from steam shovel size to about 11 inches.

One 36 x 54-in. Jaw Crusher, located beneath the primary breaker, and breaking from 11 to 5 inches.

Four Special Gyratories equivalent to about No. 9 in size, located in a group, below the secondary jaw crusher, and breaking from 5 to 2 inches.

One 42-in. Incline Belt Conveyor, 797 feet long, delivering the 2-in. crushed material to storage.

Following the coarse crushing plant and storage is the roll, screen and cobbing plant. This consists of two sets of Garfield Rolls, 78 x 20-in. in size, operated in closed circuit with 11 sets of vibrating screens and magnetic separating drums known as cobbers. In this plant the material is reduced to about 6-mesh size, but only about 65 percent by weight is so crushed, approximately 35 percent being rejected in transit by the cobbers and delivered to shipping bins as a clean, hard crushed stone from 2-in. to 6-mesh size, which is sold. Minnesota State Highway No. 35, the concrete road connecting the Mesabi Range cities, was largely built with this stone. The revenue from this by-product is considerable.

The 6-mesh product (locally called "cob") having been raised in iron assay to 38 percent or 40 percent by the elimination of the stone, goes to storage, from whence it is drawn as required by belt conveyors and delivered to the wet mill. All work up to this point has been done dry, but here the cob has water added, passing over a set of wet magnetic cobbing drums, where approximately 15 percent to 20 percent of the weight of original feed is discarded as a 6-mesh wet tailing, clean, hard and silicious, used for road dressing, concrete block making, roofing granules, and for other purposes. It is possible at this stage to remove some high grade concentrate, but it can be and is better done later.

The partially concentrated cob, weighing now from 45 percent to 50 percent of the original feed, goes next into a wet closed circuit consisting of ball mills, classifiers, tables and magnetic log-washers. The tables deliver a 12-mesh concentrate assaying 64 percent to 66 percent iron, their tailing going back into the closed circuit. The magnetic separators deliver a 100-mesh concentrate also assaying 64 percent to 66 percent iron, with clean tailing to waste.

The mill proper therefore takes in one material—steam shovel rock—and delivers the following products:

1—Crushed stone, from 2-in. to 6-mesh—to market.

2—Coarse tailing, 6-mesh to about 2-mesh—to market.

3—Fine tailing, 100-mesh and finer—to waste.

4—Coarse table concentrate—12 to 100-mesh.

5—Fine magnetic concentrate—passing 100-mesh.

The general metallurgical plan is to eliminate the silica at the earliest moment possible in order to avoid crushing and further handling, no concentrate being taken until fine enough in size to be of high grade. The characteristics of the magnetic separators are such that metallurgical losses are low, the tendency being for the machines to retain all fines and all uncertain or attached particles.

The coarse and fine concentrates are dropped together into a launder where from 5 percent to 7 percent of fine coal is added by an automatic feeder. A continuous drum type filter removes the excess water, leaving a product consisting solely of high grade magnetite and fuel particles, and carrying 11 percent moisture. This is sintered on standard sintering machines, the sinter going into ore cars, from which point it is handled by rail and boat just as is any other iron ore.

Power is made from slack coal in four modern stoker-fed water tube boilers, steam being at 200 pounds pressure, with 200 degrees superheat. The boiler water used is so pure that no scale forms, nor has a single tube been replaced in three years run. Two 2,000 K. W. steam turbines, run condensing, furnish enough power for a considerable increase in capacity, since the average demand at present capacity (1,000 tons of sinter daily) is around 1,600 K. W.

Even at this low power output the

Plant of the Mesabi Iron Company

power cost proved low. Electric power from hydraulic plants is also now available for future increases, a new transmission line, built by one of the public utility companies, passing some three miles from the mill.

The mill water supply is adequate and close at hand. One lake two miles away is 16 miles long, and smaller ones lie even closer.

The mill is located well up the slope on a 400-foot hill, with plenty of room for tailing disposal.

Sinter can be made of any grade desired, up to about 68 percent iron, but at a moderate added cost if above 64 percent. The analysis may be closely controlled, and the product is uniform, day by day. The present plant (doubled in capacity in 1924) readily makes a product having the following analysis:

	Pc't		Pc't
Iron (dry)	63.50	to	65.00
Phosphorus	.030	to	.024
Silica	9.00	to	7.30
Sulphur	.005	to	.004
Manganese	.15	to	.23
Alumina	.60	to	.55
Lime	.10	to	.10
Magnesia	.40	to	.38
TiO_2	.03	to	trace
Moisture	.35	to	1.00
Gain by ignition	1.80	to	1.85

The small amount of sulphur comes wholly from the coal used, none existing in the ore.

The gain by ignition is due principally to oxidation of magnetite to hematite. The amounts of magnetite and hematite in sinter may be varied to a limited extent. A strong-walled hard sinter will carry more magnetite. A softer, weaker sinter will contain more hematite. Actual experience with the material in blast furnaces fails to show any advantage for the softer sinter. Solid lump magnetite reduces with difficulty in the furnace, but magnetite sinter gives no such trouble, probably because of its structure and porosity.

Phosphorus has, for a special cargo, been brought as low as .008 percent, but the market for such material is limited.

A total of about 150,000 tons of sinter was made and shipped during the period of operation, much of this being produced while alterations and additions to plant were in progress. It found a ready market with the furnaces, and gave a good account of itself.

Close and comprehensive estimates of costs and results were made before the mill was designed and built, based on three years operation of a 100-ton pilot plant at Duluth, and on results at other plants handling similar materials.

The more than two years of plant operation at Babbitt showed these estimates to be conservative, for the expected product was made in quantity, and the actual costs were below those originally estimated for the outputs reached.

If there were anything really novel in this metallurgy or product, the position and future of the enterprise might not seem so secure; but magnetic separating and sintering plants in New York, New Jersey and Pennsylvania have been supplying considerable portions of Eastern blast furnace requirements for years, to say nothing of what has been done abroad. The novelty consisted in using the heavy machinery proven out by the porphyry copper mills, in providing for very large output when demanded, and in locating the plant in the largest established competitive iron ore producing district of the country, the wisdom of which will become more apparent as time goes on.

Steel is largely built on quantity and uniformity of fuel and ore supply. Uniformity is becoming a more important factor on the Mesabi Range. Quite generally ores are mixed or "graded" to a contract analysis before reaching the docks. As the individual ore bodies approach exhaustion, the maintaining of uniformity in these grades becomes more difficult. In recent years several large crushing plants have been installed, not only to care for harder ores and increases in size, but to assure thorough mixing for cargoes. Mesabi Iron Company does not face this difficulty, being able to hold its product at a predetermined analysis indefinitely, with almost no variation.

Sinter, or sintered iron ore, is a product somewhat resembling coke in appearance, clean, porous, readily reducible, and with cell wall structure strong enough to resist blast furnace pressure. More than 3,000,000 tons are made annually in this country from flue dust, magnetite concentrate and other fine material, and it is

Stock pile of sinter being shipped. Shows coarse open structure of material

recognized as a highly desirable blast furnace material. At least two blast furnaces have recently installed sintering capacity sufficient to allow furnace operation on 100 percent sinter. This because by experiment it was determined that the exclusive use of sinter greatly increased the furnace output, with a 15 percent to 20 percent reduction in coke used per ton of pig, and with no off-grade iron produced. A blast furnace plant represents investment enough so that any such results can not be ignored. Gains, which may be said to be roughly proportionate, come from the use of part sinter on the burden, but opinions are not so uniform as to degree of benefit as they are when sinter is used alone. Probably furnace lines, operating practice and the composition and structure of the ores used with the sinter have something to do with this. Much that goes on inside the furnace is still obscure.

Obviously it would be possible to briquet or otherwise agglomerate the concentrate as an alternative to sintering, but furnace experience so far shows no advantage in this.

The investment cost of the enterprise to date, including cost of property, exploration and development, preliminary experimental work, plant construction and demonstration, has been no greater than the cost of stripping some of the larger open pit mines. Operated on a basis of 1,000 tons of sinter per day, with an ore price which permits the average iron mine to live, the enterprise can show a satisfactory margin, which seems certain to increase because of its large deposits, consequent long life, and the improving competitive conditions under which such a life is likely to be lived out, as already indicated above. The deposit is probably large enough to sustain eventually the production of 25,000 tons of sinter per day, or say 7,500,000 tons per year, and this is what has been planned when the time comes. Such an output cannot be reached rapidly, chiefly because not demanded, but more than this has already been produced from a single Mesabi mine in the past, and it would constitute only about 10 percent of a 75,000,000-ton output.

It is not the idea nor the aim that sinter will "flood the market" or displace on a large scale ores now being mined, but rather that it will serve as a growing high grade nucleus, around which may be built from the lower grade natural ores of the Central and Western Mesabi, longer life for iron mining in Minnesota.

Beneficiation of copper, lead and zinc ores had to be resorted to years ago. As shown above, it is already producing between 15 percent and 20 percent of the iron ore output of the Mesabi Range; for it is just as much an economical procedure to remove silica from iron ores as from other ores, doing the work mechanically, close to the mine, thus saving freight and smelting cost. A high grade product has the obvious advantage of paying less freight per unit of iron contained, and in the case of such a product as sinter, of paying no freight on moisture. Natural Mesabi ores average about 12 percent moisture, with sinter ranging between absolute dryness and one percent water.

It should not be assumed that Mesabi sinter is the only possible "sweetener." The hematite ores are not directly amenable to magnetic separation, but necessity may surely be counted on to bring forth other methods as required.

The possibilities of beneficiation, and effect on the industry may perhaps be best summed up by stating that in 1911 the United States Geological Survey published its estimate that the Mesabi Range contained the following tonnages, not under rock cover:

Assaying 35% Iron. 30,000,000,000 tons
Assaying 25% Iron. 125,000,000,000 tons

And for the entire Lake Superior region, 467,000,000,000 tons. In other words, with proper beneficiation methods, these deposits give what amounts to an endless life to the steel industry of the Central United States. Metallurgically such beneficiation methods are available now. Commercially they will be applied as demanded. Competition between the natural and beneficiated ores may be keen for a few years, but there is only one outcome, and there need be no fear for the future. Lake Superior can supply the demand for centuries to come.

CHROMITE IN 1925

THE shipments of domestic chromite, all containing 45 percent or more chromic oxide, in 1925, totalled 108 long tons, valued at $2,105, according to figures compiled by the Bureau of Mines. These shipments came from two mines in California and one mine in Maryland. The production in 1925 was 157 long tons. Two mines in California, one in Maryland, one in Oregon, and one in Washington produced this tonnage. In 1924 there were 233 long tons of chromite produced and 288 long tons, valued at $1,140, shipped. Of the 288 tons shipped in 1924, 100 tons were from material mined in previous years, which contained less than 35 percent chromic oxide. Two mines in California and one in Montana produced; one mine in California and one in Oregon supplied the tonnage shipped.

The total imports of chrome ore, containing 45 percent or more chromic oxide, for 1925 were 149,739 long tons, valued at $1,207,420. Of this total the major part came from Africa, Cuba and Greece.

In 1924 the total imports amounted to 118,343 long tons. In 1925 United States imports, therefore, increased 31,396 tons. The increased output of steel during 1925 accounts only in part for the increase in imports of chrome ore. The ratio, chrome used per ton of steel produced, has also increased as chrome is being used more and more in the fabrication of special grades of steel for automobile manufacture. Furthermore, the material increase in the demand for higher grade refractories in the open hearth furnaces as well as in low temperature furnaces contributed to increased importation. The chemical uses have remained relatively constant.

During the year the price of 45 to 50 percent chromic oxide ore has varied between $20 and $23 per short ton f. o. b. shipping point. Ores running from 52 to 54 percent chromic oxide have averaged approximately $24 per short ton.

More than seven-tenths of the world's production now comes from Rhodesia. The mines are highly developed and are probably more extensive and more important commercially than any others now known. The cheapness with which the ore is mined and transported has made production from other world sources unremunerative. Relatively little New Caledonian ore is now produced. The Greek mines are still being operated by American interests. The Brusa mines of Anatolia have not produced since 1918. This does not mean that the ore has been exhausted, but that the mines of this locality would find difficulty in competing with Rhodesia, at best, and political conditions in Anatolia are not now favorable for mining. The production of India and Baluchistan has remained constant. The shipments from Cuba show an increase of slightly more than 200 percent. The ore carried 42.6 percent chromic oxide.

The article on "Description of Jigging Process at Mary Ellen Mine" by A. K. Knickerbocker, scheduled to appear in this issue, will appear in a later number.

A loss of almost 50 percent of the coal in Illinois results from present methods of coal mining, according to a report of the State Geological Survey. The survey covers 11 fields in 27 counties, representing nearly the entire output of the state. In the mining of 69,785,000 tons of coal, the report states, 67,045,000 tons was lost. Pillars account for most of the loss, the average being 39 percent, but investigation showed that 32 percent of the loss was avoidable.

CHANGES IN THE TREATMENT OF WASH ORES

A Review Of The Various Methods Used In The Treatment Of Low Grade Ores In The Lake Superior Districts With Particular Reference To The Results Obtained By The Dorr Bowl Classifiers

By HARRY W. NEWTON *

A BRIEF resume' of the geology of the iron ore bodies of the Mesabi Range will assist in an easier understanding of the causes underlying the necessity for washing or "beneficiation" of the ores, which today is universal practice in that district.

These deposits had their origin in an older iron bearing sedimentary rock, locally known as taconite. Weathering and decomposition broke the taconite down into iron oxides and silica sand, and these decomposition products suspended in water, were in turn carried off, and by natural concentration deposited according to specific gravity and state of subdivision.

Rates of flow, dilutions and other conditions influenced this sedimentation and the resultant deposits range from practically pure iron oxide to clean silica sand. In some cases lighter solids settled upon heavier solids already deposited, and many of the large ore bodies present layers of clean iron oxide interspersed with layers of unclassified solids, or of silica sand. These mixed bodies are the so called "wash ores" of the Mesabi Range, and have left to man the problem of carrying to completion Nature's unfinished work.

Fortunately the irregular layers of sand and ore are not as a general rule cemented together into a solid rock. They are usually either simply superimposed and easily separated one from the other, or in such an imperfect state of cementation as to be readily separated by crushing and abrasion.

Where the layers of iron oxide and silica sand are of sufficient thickness, these can be separated in mining by selective methods but as a rule mining effects a very complete mixture of ore and sand, thus presenting a product low in iron, high in silica and not unlike the original taconite decomposition products.

With the discovery of large bodies of "wash ores" in the western district of the Mesabi Range, there developed a serious need for some cheap method of removing the free silica sand from the mixture as mined, and in 1902 20 tons of "wash ores" were shipped from the Arcturus mine to the mill of the Alabama & Georgia Iron Company at Cedartown, Ga., for treatment tests.

The Cedartown mill consisted of a Thomas Log-washer followed by a rinsing screen and the ore after grizzly sizing, was sluiced to the log-washer from which the lighter solids overflowed with the water. The heavier solids settled in the log-washer tank and were advanced by the spiral flight of the log shafts, up the inclined deck of the tank to discharge into the rinsing screen. In the rinsing screen which was a compound screen trommel, the coarser materials were removed by the inner screen used as a protection for the 30-mesh wire cloth of the outer jacket, and the undersize was sprayed and screened for the removal of minus 30-mesh fines.

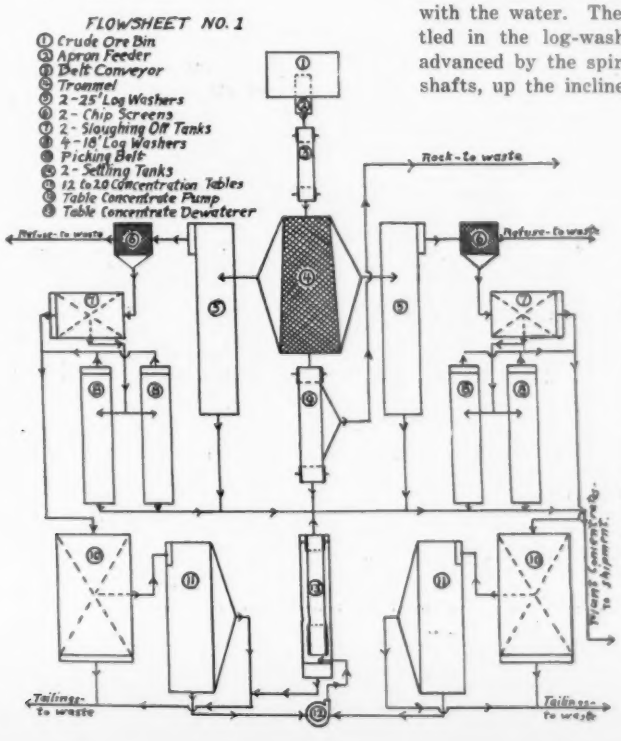
This crude treatment demonstrated that a merchantable product could be made from the Arcturus ore, the iron content having been raised from 45.4 percent in the crude ore to 62.8 percent in the concentrate with a tonnage recovery of approximately 60 percent.

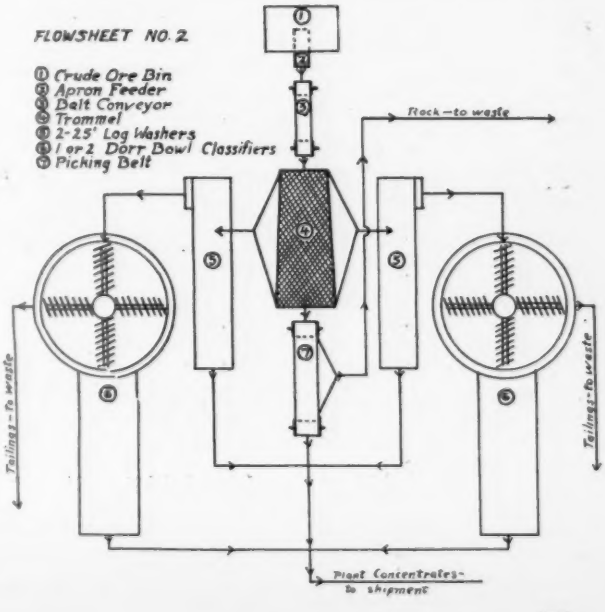
Following this test a small mill was built at the Arcturus mine and later a similar one was erected at the Holman mine.

In 1905, the Oliver Iron Mining Co. became interested in the beneficiation of the sandy ores of the Western Mesabi, and after an investigation of practices at ore washing plants in the south, erected an experimental mill at Coleraine, Minn. The original equipment included a trommel with 2-in. round screen openings, a log-washer, and a compound rinsing trommel equipped with 3/8-in. and 30-mesh screens. Later other sizing and concentrating machines of that period were tried out.

After seven months of testing it was decided to adopt the coarse trommel and the log-washer as part of the equipment for a commercial plant and to add such other equipment as might be nec-

* The Dorr Company.





essary for the recovery of fine iron oxide overflowing the log-washer.

In 1909, plans were completed and construction work started on the Trout Lake mill at Coleraine, Minn. This was the first concentrating plant to commercially treat the low grade sandy ores of the Western Mesabi and is at present the largest mill on the range. At that time it consisted of five units and had a total capacity of approximately 1800 tons of concentrate per hour. The wash ore feed for each unit was brought over a high trestle to the top of the mill and dumped into receiving bins. It was hydraulically sluiced from the bins over a bar grizzly as needed. The grizzly oversize fell off into waste bins and was hauled to dumps. The grizzly undersize passed directly into a conical trommel with 2-in. diameter screen openings, the trommel oversize falling onto a picking belt, from which the rock was removed by hand as the coarse material was conveyed to the shipping bin.

The undersize product of the trommel was split, and fed to two log-washers, the concentrate from which dropped to the shipping bin. The overflow from the washers passed through revolving chip screens into "sloughing off" tanks. The overflow from the "sloughing off" tanks, passed to settling tanks, and the underflow constituted the feed for two smaller log-washers, locally known as "turbos." These log-washers recovered a concentrate which dropped to the shipping bins, the overflow joining the overflow from the "sloughing off" tanks in the settling tanks. Underflow of the settling tanks was fed to concentration tables, the overflow joining table tailings to waste.

The machinery for a standard unit consisted of one trommel, two log-washers, two "turbos" and 20 concentration tables, with the necessary chip screens, "sloughing off" tanks, settling tanks, table concentrate sand pumps, picking belts, etc.

Following the completion and successful operation of the Trout Lake Concentrator, several other mills were built. These were mostly patterned after the Trout Lake plant and by 1919 there were 14 such plants, all using substantially the same flowsheet. In several of the mills, however, the concentration tables were omitted, as opinion was divided as to the savings resulting from their operation. Practically all of the mills had included an additional "turbo" for each log-washer in an effort to reduce losses. Three of the plants had carried out some experimental work with hydraulic classifiers.

All of the washing plants were of splendid construction and equipment arrangement. The machines were sturdy and stood up well under the almost continuous overloads imposed on them by the demand for maximum production. Uninterrupted operation, low treatment costs and high production were the objectives at that time, and it was some time before changing conditions enabled the operators to devote themselves to a more thorough study of metallurgical efficiencies.

Washing plant recoveries averaged approximately 62 percent of the tonnage fed, with an average iron unit recovery of about 84 percent.

A closer study of the characteristics of the ore and a more thorough investigation of the concentration taking place in the various steps of the process, indicated that with the exception of some abrasion of the coarser sizes in the trommel and log-washers, actual concentration was confined more particularly to the minus 65-mesh sizes. Tests showed all the free silica to be finer than 65-mesh.

Realizing the need for increased abrasion to break down the coarse and intermediate sized ore particles, and for more efficient concentration of the fines, Dr. E. W. Davis, Superintendent of the Mines Experiment Station at the University of Minnesota, carried out a series of tests with a view to working out a process for increasing recovery, and possibly simplifying the flow sheet.

Preliminary investigation showed that equipment used for somewhat similar duty in other fields offered possibilities, and particularly such equipment as had been used successfully for concentration in other branches of the metallurgical field.

After the expenditures of considerable time and money a single machine was developed for accomplishing the entire beneficiation of Mesabi Range wash ores.

This machine, known as the Dorr Washer, consisted of a revolving cylinder, fitted with cast heads similar in

THE DORR BOWL CLASSIFIER

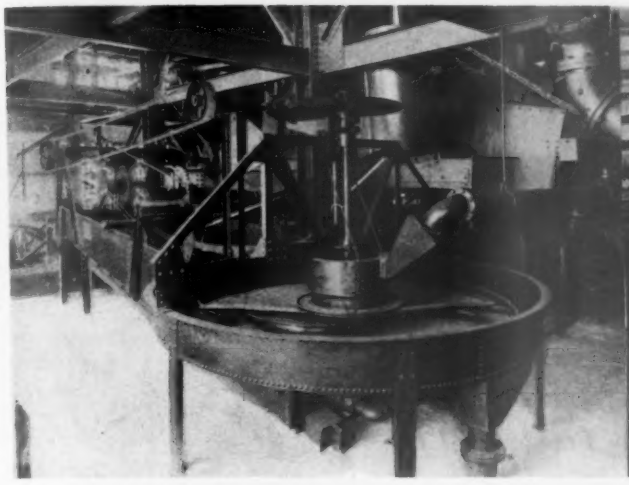
Recovery of Fine Ore from Washing Plant Pulp

Calculated average grades recoveries and screen analyses from sixteen tests covering season's investigation to determine efficiency of the Dorr Bowl Classifier as compared with turbos and tables with their required chip screens, settling tanks, concentrate dewaterers, pumps, etc. All feeds and products were sampled and weighed separately throughout the season's test work so no assumptions or estimates have been made. One 6' x 30' x 18' Dorr Bowl Classifier was employed in competition with 3 to 4 turbos and 8 to 12 tables.

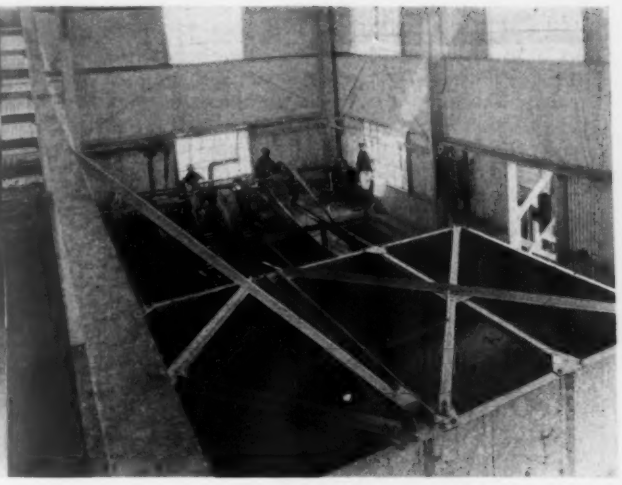
With Plant Using Trommel Logs, Turbos and Tables

MATERIAL	NATURAL WEIGHT	% RECOVERY BY WEIGHT FROM CRUDE	% IRON RECOVERY FROM CRUDE	% RECOVERY BY WEIGHT FROM ASSIGNED	% IRON RECOVERY FROM ASSIGNED	% OF TOTAL CONCT.	% DRY IRON	% NATURAL IRON	% SILICA	% MOISTURE	4 MESH % WT.	4 MESH % Fe	4 MESH % SiO_2	10 MESH % WT.	10 MESH % Fe	10 MESH % SiO_2	30 MESH % WT.	30 MESH % Fe	30 MESH % SiO_2	40 MESH % WT.	40 MESH % Fe	40 MESH % SiO_2	60 MESH % WT.	60 MESH % Fe	60 MESH % SiO_2	80 MESH % WT.	80 MESH % Fe	80 MESH % SiO_2	100 MESH % WT.	100 MESH % Fe	100 MESH % SiO_2	-100 MESH % WT.	-100 MESH % Fe	-100 MESH % SiO_2
CRUDE ORE	2,420,800	100.00	100.00				46.47	62.64	28.36	8.23	37.02	59.11	9.51	9.06	55.78	9.71	3.02	58.68	11.08	1.90	57.80	12.88	2.16	57.26	14.23	3.83	54.21	18.61	2.01	49.46	29.19	30.22	19.34	67.95
TROMMEL CONCT.	661,300	27.32	33.48			41.17	58.11	85.39	11.15	4.78	73.22	78.61	10.06	2.00	85.54	11.57	0.73	88.06	12.69	0.51	88.01	13.00	0.96	88.96	12.50	0.60	58.23	13.15	0.21	36.78	14.19	1.91	36.67	46.43
LOG CONCT.	676,400	27.94	36.81			42.11	66.93	86.18	8.48	1.42	66.87	66.68	7.03	23.46	64.58	7.17	9.86	64.43	7.83	7.86	64.75	7.63	6.10	64.70	7.63	1.96	64.76	7.29	0.98	64.08	8.40	1.65	47.68	27.39
LOG OVERFLOW	1,083,100			100.00	100.00		29.62		32.52		0.64	60.71	7.26	1.35	57.40	12.57	1.85	58.82	14.65	6.36	55.33	16.23	7.17	57.09	16.43	6.18	54.30	17.05	4.33	49.22	26.04	18.66	30.98	63.42
TURBO CONCT.	251,500	10.35	11.75	23.22	42.54	15.68	58.31	68.38	12.75	17.11	0.19	67.43	23.08	2.63	54.10	18.60	6.18	57.53	12.86	29.16	51.46	13.43	25.66	29.81	19.65	16.11	48.31	9.51	3.00	61.12	9.74	12.65	55.12	17.63
TABLE CONCT.	917,200	0.71	0.80	1.59	2.83	1.07	59.05	68.95	11.15	18.63	0.87	86.24	11.25	9.53	66.22	5.56	4.83	60.47	6.31	5.52	57.48	9.20	7.62	59.76	10.90	15.15	59.38	11.35	12.46	59.98	11.85	49.24	38.71	12.28
TURBO & TABLE CONCT.	268,700	11.10	12.55	24.81	45.43	16.72	58.41	68.36	12.69	17.81	0.80	68.11	22.68	2.72	52.83	17.33	6.10	57.48	12.83	27.68	51.98	13.43	23.50	31.81	18.83	16.07	48.25	10.05	7.35	61.19	9.57	14.16	54.25	16.78
TOTAL CONCT.	1,606,400	66.36	84.88			100.00	59.27	84.35	10.32	7.97	59.68	59.28	9.63	11.01	61.01	7.88	9.36	69.55	8.97	8.71	70.96	11.08	9.57	69.65	9.91	3.51	60.14	9.65	1.57	64.19	9.06	4.55	49.85	24.90
PLANT TAILINGS	814,400	33.64	15.12	75.19	54.57		21.00		64.44					0.04	26.31	56.08	0.65	47.81	22.51	1.96	54.01	17.42	3.33	53.65	18.86	4.16	48.79	25.10	3.65	41.11	34.84	86.39	18.35	66.23
WITH PLANT USING TROMMEL LOGS & DORR BOWL CLASSIFIER.																																		
CRUDE ORE	2,440,100	100.00	100.00				46.60	62.94	28.18	7.85	41.72	57.50	0.88	8.20	59.79	9.93	4.30	58.01	12.31	7.01	57.80	13.91	4.88	57.07	14.28	3.75	54.12	17.45	1.81	50.27	29.26	32.06	19.48	67.42
TROMMEL CONCT.	671,200	27.85	33.85			39.52	58.09	83.27	11.37	4.85	74.16	18.56	10.68	1.96	21.97	13.47	0.73	57.05	16.67	0.80	57.91	13.66	0.91	57.38	14.38	0.52	57.68	13.91	0.19	53.81	17.07	1.87	34.44	48.41
LOG CONCT.	664,100	27.58	34.27			39.18	66.85	86.47	8.13	1.21	43.48	64.58	7.34	24.40	62.36	7.18	9.41	62.25	7.51	10.10	61.98	8.87	8.01	62.57	7.88	2.08	63.45	7.48	0.88	57.38	8.43	3.75	48.70	29.89
LOG OVERFLOW	1,076,200			100.00	100.00		29.83		32.12		0.86	60.51	10.68	0.82	58.51	15.66	1.82	59.58	21.34	6.97	56.33	15.16	8.42	57.69	13.87	8.17	53.36	17.58	4.93	49.36	32.58	68.31	20.60	65.97
BOWL CLASS. CONCT.	362,300	15.03	16.94	33.13	60.16	21.36	58.76	68.46	12.38	17.66	0.71	45.66	28.21	2.51	33.78	16.56	3.58	36.72	12.32	34.20	39.13	11.59	23.28	29.66	11.45	19.63	51.87	12.09	8.83	60.37	11.12	15.06	32.19	13.66
TOTAL CONCT.	1,698,200	70.46	89.06			100.00	59.32	84.21	10.28	8.20	54.54	55.46	9.68	10.76	61.71	7.59	9.31	68.78	8.89	8.90	69.30	10.37	6.37	68.46	10.41	4.76	58.71	11.34	2.72	60.65	10.84	5.18	51.02	22.16
PLANT TAILINGS	741,900	29.54	10.94	66.87	39.84		19.38		69.87								0.03	30.96	30.06	0.62	42.88	30.96	0.43	44.64	29.26	1.09	39.52	37.60	1.82	34.92	46.79	126.11	18.30	68.86
INCREASED RECOVERY BY BOWL CLASS.		3.93	0.12	8.92	15.33																													

NOTE.—*Log overflow and tailings analyses calculated from we ighed products as sampling methods gave concentrated samples. Screen analyses from log overflow and tailings samples.*



Typical Dorr Bowl Classifier Installation



Typical Installation of a Dorr Washer

construction to those of a ball or rod mill, the cylinder being of heavy perforated metal. This drum was mounted over a sloping shallow tank, fitted with a mechanism which was similar to that which had been successfully used in other fields in the Dorr Classifier.

Wash ores passing a grizzly with 4½-in. openings were fed into the revolving cylinder through the hollow trunnion of the feed head casting. Lifters kept the ore and water in agitation and advanced it slowly toward discharge. The ore particles, working upon one another, freed the cemented silica sand and all fines were screened through the cylinder perforations, into the classifying tank, by the pulp of the submergence.

The oversize, upon reaching the discharge end of the cylinder, was picked up by a dewatering scoop and discharged into a perforated cylinder inside the hollow trunnion of the discharge head. After being sprayed with clear water for a more complete removal of fines it was discharged in a slime free, dewatered condition.

In 1920, one of these units was installed at the Marista mine near Gilbert, Minn., for the treatment of the sandy ores from this underground property.

Ore was hoisted by skip and dumped over a stationary grizzly, the undersize dropping into the skip pocket formerly used for loading merchantable ores into railway cars. Ore was drawn from the pocket and conveyed to the Dorr Washer by an Apron Feeder. The Dorr Washer was mounted on a low substructure just above ground level and the washer concentrates were carried to the loading bin by an inclined belt conveyor.

This single low cost plant is handled by one man per shift and requires less than 25 horse power for its operation. It produces from 45 to 55 tons of concentrate per hour, recovering from 75 percent to 80 percent of the feed tonnage and from 85 percent to 92 percent of the iron of the feed. Water requirements are materially less than those for log-washing plants.

Two Dorr Washers, each with capacity of 100 tons of concentrates per hour have since been installed on Minnesota Iron Ranges and a fourth machine with 150 tons hourly capacity is now being installed at the Corsica mine of Pickands, Mather & Company, near Gilbert, Minn.

Following the successful demonstration of these units, it became apparent that there was a real need for some simple machine which could be fitted into the flow sheet of the older plants following the log-washers, to recover the fine iron oxide which was being carried off in the plant tailings.

Observations of the operation of the Dorr Washer, indicated that a machine along the lines of a Dorr Classifier was able to make a separation of fine iron ore and silica sand, and this resulted in the development of another special machine, capable of receiving the entire flow from a log-washer and separating it into a concentrate and a plant tailing.

This Iron Ore Bowl Classifier was installed at the Quinn-Harrison Washing Plant at Butler Brothers in 1924.

Tests were conducted throughout the washing season of 1924, and proved that a single Iron Ore Bowl Classifier, could receive the entire overflow from two log-washers and separate this into a finished concentrate and tailing, with added tonnage and iron unit recoveries, over the old system. The installation of a Bowl Classifier eliminated two chip screens, two "sloughing off" tanks, two settling tanks, four "turbos" and from 12 to 18 concentration tables with table concentrate pump, concentrate dewaterer and tailings pump. The average of these tests is shown in the table on page 274.

Flow sheets Nos. 1 and 2 show a one-unit washing plant arrangement before and after the installation of the Special Iron Ore Dorr Bowl Classifier.

Following the tests at the Quinn-Harrison Washing Plant, nine additional machines were purchased by various iron-mining companies to replace turbos and tables, and were put into operation during the washing season of 1925. At least 19 will be in operation at the opening of the 1926 season.

PRODUCTION OF MAGNESITE IN 1925

STATISTICS compiled by J. M. Hill, of the Bureau of Mines, show that the production of crude magnesite mined in the United States in 1925 was 120,660 short tons, valued at $1,432,700. Six operators at seven mines in four counties in California produced 64,600 tons of magnesite, valued at $872,100, all of whom reported only fair business due to foreign competition. All of the output in Washington was from the mines of one magnesite company, which operated only one of its six furnaces at Chewelah, Stevens County.

Sales of magnesite of domestic origin in 1925 were 2,090 tons crude, 23,900 tons of caustic calcined (a decrease of approximately 10 percent as compared with 1924), and 29,110 tons of dead-burned (nearly the same as in 1924), having a total value of $1,733,950.

Imports of magnesite in 1925 were 4,429 tons crude, valued at $54,593, most of which came from Italy; 17,102 tons of caustic calcined, valued at $414,734, over half of which came from India; and 47,613 tons of dead-burned, valued at $703,074, practically all of which was from Italy.

The total production of crude magnesite produced in the United States from 1886 to 1925, inclusive, is 1,806,060 tons, valued at $15,258,490.

COAL

PRACTICAL OPERATING MEN'S DEPARTMENT

Practical Operating Problems of the Coal Mining Industry

LOW COAL MINING AT GLEN WHITE

Mechanical Methods Used In Mining Three Foot Seam—Safety, Simplicity, Moderate First Cost, And Low Operating Cost Essential To Successful Operation—Twenty Thousand Tons Mined Out as Described—Results Show One And Quarter Tons Delivered Shaft Bottom Per Man Hour

By C. R. STAHL *

THE lease of the E. E. White Coal Co., lies in Raleigh County, W. Va. The Beckley coal bed exists throughout and is the principal seam mined. This famous coal bed is noted for its irregularity and in the Glen White mine is found to vary in thickness from three to 10 feet. It having been found too costly to mine the three-foot coal by high coal methods it was decided to mine this low coal by mechanical methods.

Roof control is no more difficult in the Beckley than in other coal beds; but while any roof condition can be taken care of by the room and pillar system of mining, mining men who have attempted to control the roof on a long face have usually failed at it excepting under special conditions.

Any thought of breaking the roof at predetermined intervals was therefore dispensed with; in fact it was decided to mine the coal without breaking the top at all. The Beckley coal bed is overlaid with hard sandstone 80 feet or more in thickness while the bottom is a shale much softer. The total cover over the low coal is about 500 feet. It was thought that a supported roof under pressure would cause the bottom to heave and meet the top without inducing either squeezes or heavy roof falls. Packwalls for supporting the top are too expensive in a clean seam of coal. Cogs and cribs when tried experimentally failed to give the support desired. Therefore, in this system of mining, the roof is supported by coal pillars left for the purpose at predetermined places. A cubic yard of coal weighs about a ton and will support more weight than 50 times its value in packwalls, cribs, or other roof supports.

In planning the method of attack the following points were kept constantly in mind:

(1) *Safety.* We did not think that any plan which required the use of ventube and blowers would be consistently satisfactory from a safety standpoint.

(2) *Simplicity.* Many plans for mechanical mining have been developed which are too complicated. It is too often expected that a complicated system of work and sequence of operations can be developed and placed in use by ordinary mining men. These work for a while but usually fail as soon as the newness wears off and the attention of the management is diverted to other things.

(3) *Moderate first cost.*

(4) *Low operating cost.*

We believe that any plan of mechanical mining which ignores any of the four features mentioned will be unsuccessful. We think that the steps should be gradual; should be evolutionary instead of revolutionary; and that by advancing one step at a time, the entire operation of moving coal and rock mechanically will eventually be mastered.

The low coal section is so laid off that cross entries intersect the machine entries at intervals of about 2000 feet. In this respect the system is no different from the room and pillar system.

The machine entries (corresponding to the conventional room entries) are driven 20 feet wide with a 30-foot pillar between. The space between the pairs of machine entries is 250 feet. In the center of this space a 30-foot pillar is left parallel to the entries and as the long face advances this pillar is punctured every 80 feet for ventilation. The distance from this pillar to the machine entry pillar is, therefore, 120 feet. This was considered the maximum span which could be handled without excessive timber cost. The arms of the Y are at an angle of 45 degrees with the entries. The two entries are the stem of the Y and the arms of the Y constitute the long faces. The stems of the Y point inward advancing, and outward retreating.

The arms of the Y are not worked simultaneously. Instead the two adjacent arms of a pair of adjacent Ys are worked advancing thus working out

* Superintendent, E. E. White Coal Co., Stotesbury, W. Va.

the alternate blocks advancing and leaving alternate blocks to be worked retreating. It will be noted that this system makes for an effective system of ventilation with the air current sweeping the long face at all times.

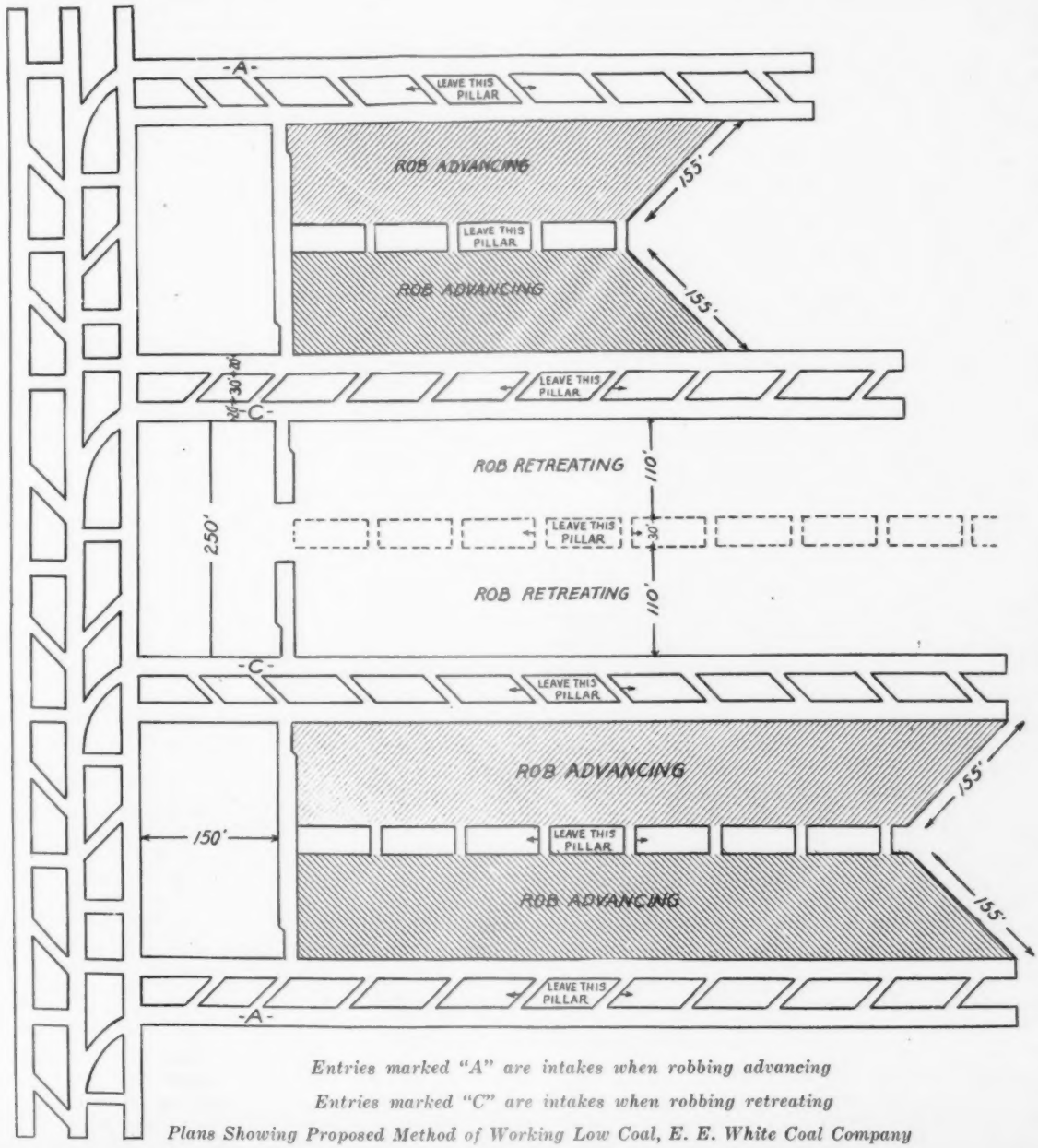
The entries are driven in the conventional manner; it being thought best not to mechanicalize these at the start, but to leave the mechanical loading of entry coal and gobbing of entry rock until the work on the loading faces had been well standardized. As noted, the entries are driven 20 feet wide. This leaves room for gobbing the bottom slate. Bottom is shot in all the entries as the mechanical loading requires 20 inches height over the mine car.

The work of driving the entries and taking bottom is conducted independently of the work of extracting the coal from the long faces. As the angle between the long face and the entry is 45 degrees, a 6-foot daily advance of the long face calls for an entry advancement of nine feet per day. On the retreating work of course there is no entry problem.

The angle of 45 degrees gives a face about 155 feet long and with us this is a convenient length of face to work. Physically, the angle could be varied several degrees either way without affecting the efficiency of the system.

The pillars left are not to be drawn. Leaving them is a part of the system of mining. In practice we have secured a recovery of 85 percent. Experience indicates that this recovery is always possible in three to three and a half-foot coal and it is probable that it will eventually be increased to 90 percent.

The long face mining is done on two shifts. One shift consists of two men. These men cut the coal, haul supplies, timber the face, and drill the shot holes. The cutting is done with a shortwall machine with a 6-foot cutter bar and



Entries marked "A" are intakes when robbing advancing

Entries marked "C" are intakes when robbing retreating

Plans Showing Proposed Method of Working Low Coal, E. E. White Coal Company

the shot hole drilling is done with an electric drill.

The opposite shift which moves the coal consists of six men as follows: 1 drum-runner, 1 motorman, 1 brakeman and car trimmer, 1 bell ringer (boss), 2 face men.

The coal is loaded into the mine cars by means of a Goodman Type A scraper loader. It is mandatory that the face be cleaned up regardless of delays. About half the time of the men is taken up in the actual loading. The balance of the time is required for moving the chute, setting jacks, shooting coal, etc. The occupation names given above are general in character and at times any or all hands are called upon to assist in other portions of the work.

This crew loads out the coal and delivers the loaded cars to the parting (in our case at the shaft bottom). While the motor crew is away hauling loads or securing empties, the balance of the men are breaking down coal, shifting jack pipes, cleaning road, etc. The work is so organized that there is no waiting and no shouting.

It should be stated that while the plan is laid out to be half advancing and half retreating, the work so far done has been done on the retreat on entries driven in advance for the purpose. The results have been such that the next pair of machines put to work will be placed on an advancing face. When the work is done altogether on the retreat, it is found to be more convenient to work both arms of the Y simultaneously instead of working one arm only of each of two adjacent Ys as in the advancing retreating system.

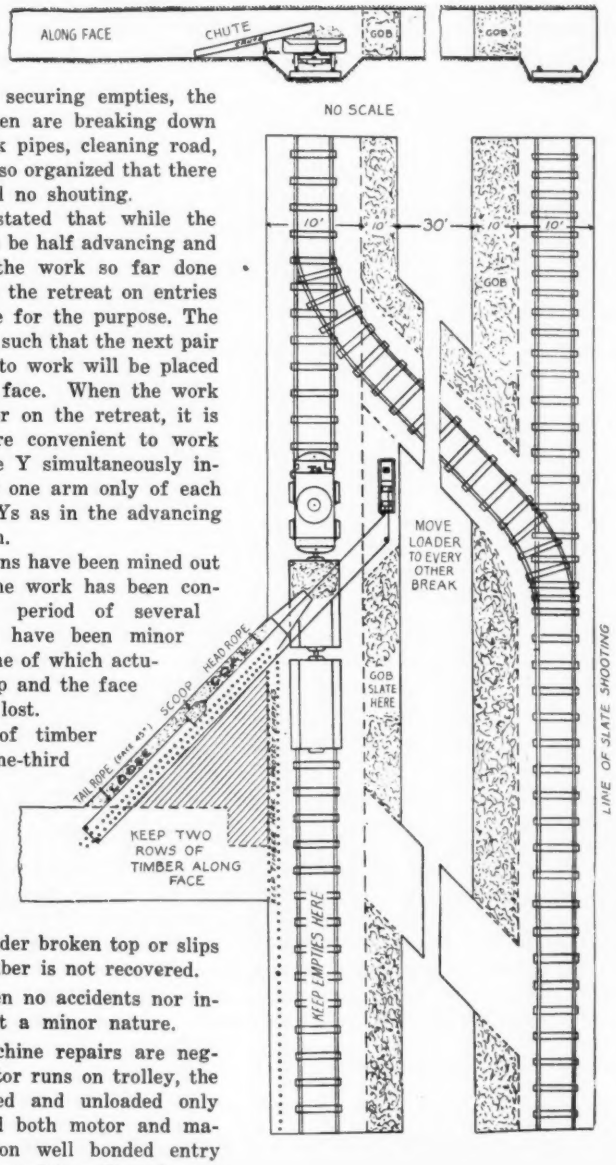
About 20,000 tons have been mined out as described. The work has been continuous over a period of several months. There have been minor roof falls but none of which actually broke the top and the face has never been lost.

The amount of timber used is about one-third in excess of that required in the conventional room and pillar work. Occasionally cogs or cribs are built under broken top or slips in the roof. Timber is not recovered.

There have been no accidents nor injuries of any but a minor nature.

Motor and machine repairs are negligible as the motor runs on trolley, the machine is loaded and unloaded only once a shift, and both motor and machine run only on well bonded entry track. The hoist used is well made and repairs to this equipment are also light in character. The principal extra expense incidental to this method of mining aside from the timber is the cost of the loading machine ropes. One set of ropes will load 2000 tons. The scoop (or submarine) and chute have a life of about 25,000 tons. An incidental use of the hoist is to drag the mining machine into place for cutting and to transport timber from the entry to any point along the face. Expenses not noted above are the cost of powder, general mine supervision, power, overhead, and the cost of driving the entries.

The work is essentially gang work and all the men are paid motorman's wages except the boss. The boss has to be a good mining man and has to be as well equipped in every way as a good section foreman in any other class of work.



The results attained in practice on the long face have been about one and a quarter tons delivered to the shaft bottom per man hour.

Not much is known about the supporting power of coal and research in this line is needed. We believe, however, that the system should not be used for coal more than four feet in thickness. The pillars left would have to be greater and this would give too low a recovery. It is probable also that the top would ride the coal instead of meeting the bottom. The lowest coal we have mined has been 30 inches thick, but if valuable enough, coal two feet thick could be worked. The system is good only for strong top and clean coal. For weak top or dirty veins a face conveyor should be used instead.

PRODUCTION OF ALUMINUM IN 1925

THE value of new aluminum produced in the United States during 1925 was $36,430,000, a decrease of a little over 3 percent as compared with 1924, according to information furnished J. M. Hill, of the Bureau of Mines. The decrease was in part attributable to the drought in the eastern states, which caused the shutting down of two plants for some weeks. Virginia aluminum of 99 percent grade was quoted at 28 cents a pound, and the 98 percent grade at 27 cents a pound until the last of October, when an advance of 1 cent was made in each grade. The price was reduced to 28 cents and 27 cents the first week of 1926. Aluminum bronze powder was used in increasing amounts for oil tank and interior shop painting, because of its high reflective and protective properties. Aluminum furniture was developed during 1925. The electrical industry still consumed large quantities of the metal, but the automobile industry remained the largest consuming industry.

Imports ("general") of aluminum metal, scrap, and alloy in 1925 increased nearly 48 percent as compared with 1924, reaching a total of 43,409,546 pounds valued at $10,180,497, in 1925. Imports of plates, sheets, and bars, on the other hand, decreased 87 percent, amounting to only 102,338 pounds, valued at $47,740, in 1925.

Exports of aluminum ingots, scrap, and alloys in 1925 were 8,130,222 pounds, valued at $1,835,213, an increase of 142 percent as compared with exports in 1924. Exports of plates, sheets, bars, etc., in 1925 were over 50 percent greater than the quantity sent abroad in 1924, but tubes, moldings, castings, and table and other manufactured ware were exported in about equal amounts in 1924 and 1925. The total exports of aluminum in 1925 were 19,105,226 pounds, valued at $6,057,071.

FACE CONVEYORS WITH CONCENTRATED MINING SYSTEM

In Spite Of The Adoption Of Many Efficient Methods To Eliminate Delays, Men From Face To Tipple Are Still Handicapped In Securing Continuous Flow Of Coal To Railroad Car—How Conveyors May Be Used To Simplify The Problem

By FRANK S. FOLLANSBEE *

COAL mine operators now generally realize that to secure reductions in the unit cost of producing coal, methods that will increase the tonnage per man employed must be adopted.

This involves a scheme whereby the handling of coal at the face is made easier for the loader, and the duties which have to be performed between the solid coal face and the placing of coal on the railroad cars in marketable form, are reduced to a minimum and so systematized as to cause the least interference and subsequent delays.

To accomplish this end with the conventional room and pillar system of mining, certain changes have been inaugurated in many mines.

Larger mine cars are used to increase the actual loading time of the miner. To aid the loader these cars have been made longer, wider and lower.

The cutting of the coal has always been difficult to regulate. The necessity of cutting rooms in sequence, the time required to shift the machine from place to place, results in idle time for the loader, and interference with the gathering of cars from the room. To remedy this situation, cutting crews have been put on the non-producing shifts. This insures the loader of more cars delivered to his face and fewer interruptions.

When conditions will permit, the width of the rooms are fixed to insure the loaders a sufficient fall of coal for a full day's work.

The laying of track and switches and the delivery of timber is done on the night shifts. This eliminates many delays and hindrances to coal transportation. To further speed up transportation, better track is installed and maintained which has reduced wrecks and permitted greater traveling speed.

The installation of an effective lighting system on entry and in rooms increases the efficiency of the miner and the other underground men, and in addition permits better inspection and is conducive to safety.

While these and other methods have eliminated many delays, still men from the face to the tipple are continually waiting for others to perform some task which is a necessary link in the route of the coal to the railroad car. The period of actual loading in the mine and of the tipple operation is usually limited to one shift and to secure the maximum efficiency, the flow of coal must be kept continuous during that period.

A system of mining where coal is loaded by hand into pit cars at the room face, will always be beset with delays. It involves the continual laying and maintenance of room track, switches and a gathering system which at best causes delays affecting men from the face to the tipple.

The transportation of coal by a mechanical arrangement from one long face or from several short faces to one central car loading point would eliminate the gathering system with its delays and expensive maintenance of room track, switches, partings, etc.

Face conveyors are being adapted to longwall, modified longwall and room and pillar work, and in many instances, with very encouraging results. Where trials are being made on longwall, the

* Chief Mining Engineer, The Woodward Iron Co., Woodward, Ala.

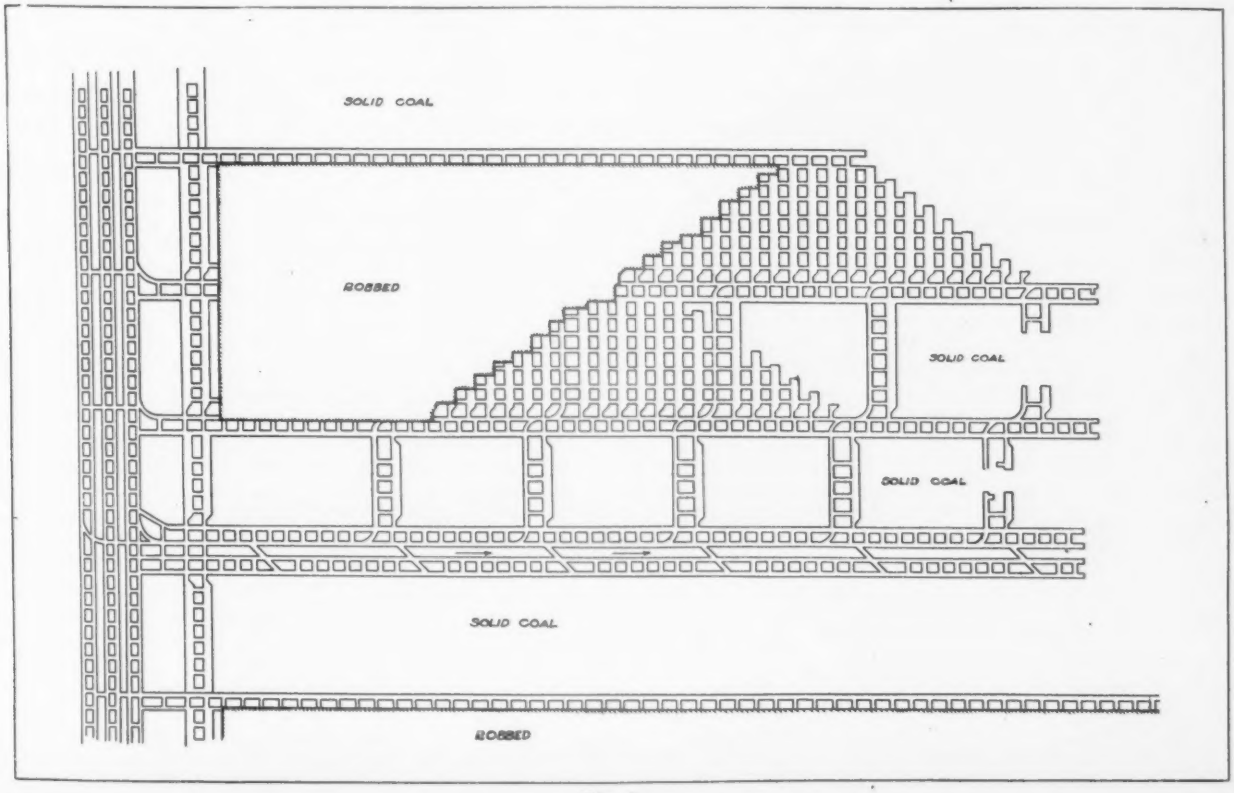


Fig. 1

chief problem is roof control, and not a question of whether the conveyor will carry the coal. The feasibility of conveyors as applied to room and pillar work is a question of the savings that may be effected by its use as compared with the cost of the system where cars are loaded by hand at the face and gathered to central parting.

The economy of such a conveyor system is largely dependent upon the degree of concentration that can be effected. A greater investment in conveying machinery and mining machines will be required by the room and pillar method than by the longwall, but this may be more than offset by the extra cost of roof control, which usually accompanies the latter.

The results that may be obtained by conveyors as applied to the room and pillar system as compared with hand loading into cars at the room faces, may be shown by a specific case. Assume an entry in a seam of clean coal 4 feet thick, where rooms may be driven 36 feet wide and 500 feet deep. A 6-foot cut across the face will give about 36 tons of coal. With hand loading and a steady supply of cars, two good men could clean up the place in one shift. But in the average mine with the gathering motor delays, and irregular car supply at the face, it will take some of the men two shifts, and the average will be nearer three-man shifts loaded out. This gives 12 tons per loader, which is probably a little above the daily output of loaders in a 4-foot seam in this country.

The advancing robbing system, (Fig. 1) where the rib drawing line follows immediately behind the room driving line, gives a maximum concentration for hand-loading into cars in room and pillar work.

The headings are worked single shift and advance 5 feet per shift. If the coal extraction in rooms and pillars follows this heading advance with the same speed, and if the coal recovery is 90 percent, one entry will produce 360 tons daily. The men required for this tonnage will be 30 loaders, two gathering crews of two men each, two track men and two cutting machine crews of two men each, or a total of 40 men, exclusive of the foremen, pumpers, brattice men, slate men, etc.

This is an average for this class of labor, of nine tons per man, from the working face to the main parting or side track. If two loaders are worked in each room, and two on each pillar, and the rooms are driven on centers that leave 50 percent of the coal in pillars there will be a total of 15 rooms on robbing and advancing.

An article in a recent edition of one of the coal mining magazines described the use of room conveyors in a mine where the coal is slightly under 4 feet thick and there is 3 or 4 inches of draw slate to be taken down and gobbed.

The equipment in the rooms consists of one drag conveyor, 12 inches high and about 18 inches wide in the bottom of the trough and made up in 6-foot sections, that can be extended to drive a room 300 feet deep. One short elevating conveyor is used at the room neck and two 12-foot belt conveyors at the room face. A shortwall machine is required for cutting the coal and is furnished without trucks since it does not have to be moved from the room. Ventilation is provided by a blower with flexible tubing. A car haul of the hoist type does away with a locomotive to pull the cars past the discharge end of the sectional conveyor for loading.

The operation is as follows: Five men are used on the conveyors, four of them being stationed at the face, and one on the entry at the car loading point. These five men do the cutting, loading, shooting, prop-setting, conveyor extending and all other work from the face to the cars on the entry. The average clean-up is about three 6-foot cuts per shift. As the room is driven, the sectional conveyor is extended along the pillar rib at each cut, and when the room has reached its limit the pillar is immediately drawn, the sectional conveyor being shortened as the work retreats.

With this system applied to the entry of the assumed operation and allowing an average of two clean-ups per face per day, 5.5 conveyor crews would be required per entry. As indicated in Fig. 2, these room conveyors would discharge onto a main conveyor which would bring the coal from all the rooms to a central loading point on the entry. This would eliminate the man at the room neck, and two men at the discharge end of the main conveyor would load the cars, cutting the conveyor crews down to 4.5 men per crew.

With conveyors, 25 men would therefore produce the same output as the 40 men used for cutting, loading, and gathering on a system where coal is loaded by hand into cars at the room face. There would be 5.5 working places per entry as compared to 15 when using cars and gathering motors and the average tonnage per room and pillar employe would be 14.4 tons placed in cars on the main parting. These figures in neither case have taken into account the loaders in the entry and air course.

The amount of coal produced per entry depends on the speed at which the entry can be driven. If the entry and air course were worked two shifts and advanced 10 feet per day, 11 conveyor crews could be worked on the day shift, and the daily production from the entry would be 720 tons instead of 360. This would make one entry with conveyors produce the same amount of coal as two entries with cars and gathering motors, and there would be only 11 active room and pillar working places as compared with 30 with loading into cars at the room face.

Frequently such a conveyor system will overcome restrictions in output due to conditions foreign to the mine development. Housing facilities is often a serious problem and here the increased tonnage per employe will permit larger mine output without additional houses. The shape of the coal area owned or controlled often limits the number of entries that can be developed and the increased production per entry with conveyors will permit larger outputs.

Such a case may be assumed and the results that may be effected by the installation of conveyors forecasted. There are 300 active employes and this is about the limit of the housing capacity of the town. Owing to the shape of the coal acreage, the development has reached the maximum number of entries that can be worked at one time, and this number of entries can be maintained for a number of years.

The seam is 48 inches of clean coal and there is 6 inches of draw slate that can be held for a while but in 50 percent of the mine it has to be taken down with the room advance.

The maximum production with hand-loading into cars, appears to have been reached and is 1500 tons per day, or 5.0 tons per employe. The 150 loaders average 10 tons per man.

With the installation of conveyors additional loaders would be made available by eliminating the necessity for 20 gathering motor men, 16 machine men, and six track men, or a total of 192 men who could be put on rooms, pillars, headings and air courses, if conveyors are used. The headings will be put on two shifts and this with the air courses will require 32 men.

No more territory is opened but the headings are driven faster. To handle the extra tonnage will require another main line motor crew. Five additional men will be required outside for the tipple and shop, and five men inside on brattice, extending track, etc.

An additional night foreman and a night gathering crew would be added. This is a total of 47 men and leaves 145 men for conveyors, which is 32 conveyor crews of 4.5 men per crew. If these men average two clean-ups per shift in a 36-foot room with a 6-foot cut and 90 percent recovery, they will load and place on the main parting 14.4 tons each, giving a total daily production of 2,088 tons. The heading and air course men will average 10 tons giving 320

tons more making a total daily output for the mine of 2,408 tons, or a 60 percent increase in production, and there are still just 300 employes.

The coal is sold at market contract prices, and during normal times this will barely pay the cost of mining and overhead, with little or nothing left for dividends or interest on the investment, even though the wage scale has been lowered to the limit.

To make the installation of conveyors advisable, it should be possible by their use to reduce the cost of coal so that the profit on the basis of present contract prices, will pay adequate return on the investment.

The hand loading rate for machine coal in this mine is 50 cents per ton. The cutting rate is 10 cents per ton, or a total for machine coal of 60 cents. The loaders at 10 tons per man earn $5.00 per day and the machine men earn $9.30 per day. There is one machine man to each conveyor crew, and using this same earning rate, the crew would have to receive $25.80 per shift, to maintain their earning power when loading into cars.

On the basis of conveyor loading with compensation to the men equal to their earnings when loading by hand into cars at the room face, the cost per ton would be almost 42 cents or a saving of 18 cents.

The total cost of the coal on a 1500-ton production basis hand loading into cars is $1.65 including all general charges. The fixed charges per ton (not per day) on this coal are, 50 cents for loading, 10 cents for cutting, 15 cents royalty, about six cents power, although this is lowered by quantity production, and about 20 cents for material which also depends on production. This leaves 64 cents for overhead expense, which varies immensely as the production increases or decreases. If the overhead is 64 cents for 1500 tons it will be 40 cents for 2408 tons. This 24 cents saving added to the 18 cent saving by conveyors on the room and pillar coal, makes a gross saving on all coal, including heading and air courses, of about 42 cents per ton. From this however, there must be deducted the additional operating cost for the extra 15 day men put on at $5.00 per day, which represents 3.1 cents per ton. Also the carrying charges on an additional investment in conveying equipment and mining machines of $9,000.00 per crew or a total of $288,000.00. If 25 percent is allowed for depreciation and material repairs on the equipment, this item will be 11.9 cents pere ton. However the material for repairs to the conveyors should be offset by the room track material saved and the 25 percent would go wholly for depreciation.

The net saving per ton realized by the installation of conveyors is therefore, 27 cents or on the basis of 250 working days per year, the sum of $162,540.00, which represents 56.4 percent return on the additional investment.

Concentration in mining may also make it possible to effect further savings by permitting the consolidation and abandonment of properties, where the total desired tonnage of an operating company is fixed.

A mining company was operating two mines of about equal tonnage, which while close to each other, were so situated that separate tipples, shops, etc., were required. The dwelling houses for the two plants were strung out along the valley, and could be used for either plant. More coal was needed but under the existing conditions could not be produced without increasing the housing facilities. Instead of adding this extra building expense to the overhead, some tipple changes were made, and railroad sidings extended, at the mine having the greatest development. The other mine was shut down, and its equipment moved to this mine. A concentrated mining system was adopted using gathering motors and cars, and at present this mine is producing 25 percent more coal than both mines did produce, and with something like 30 less day and salaried men. (*Continued on page* 293)

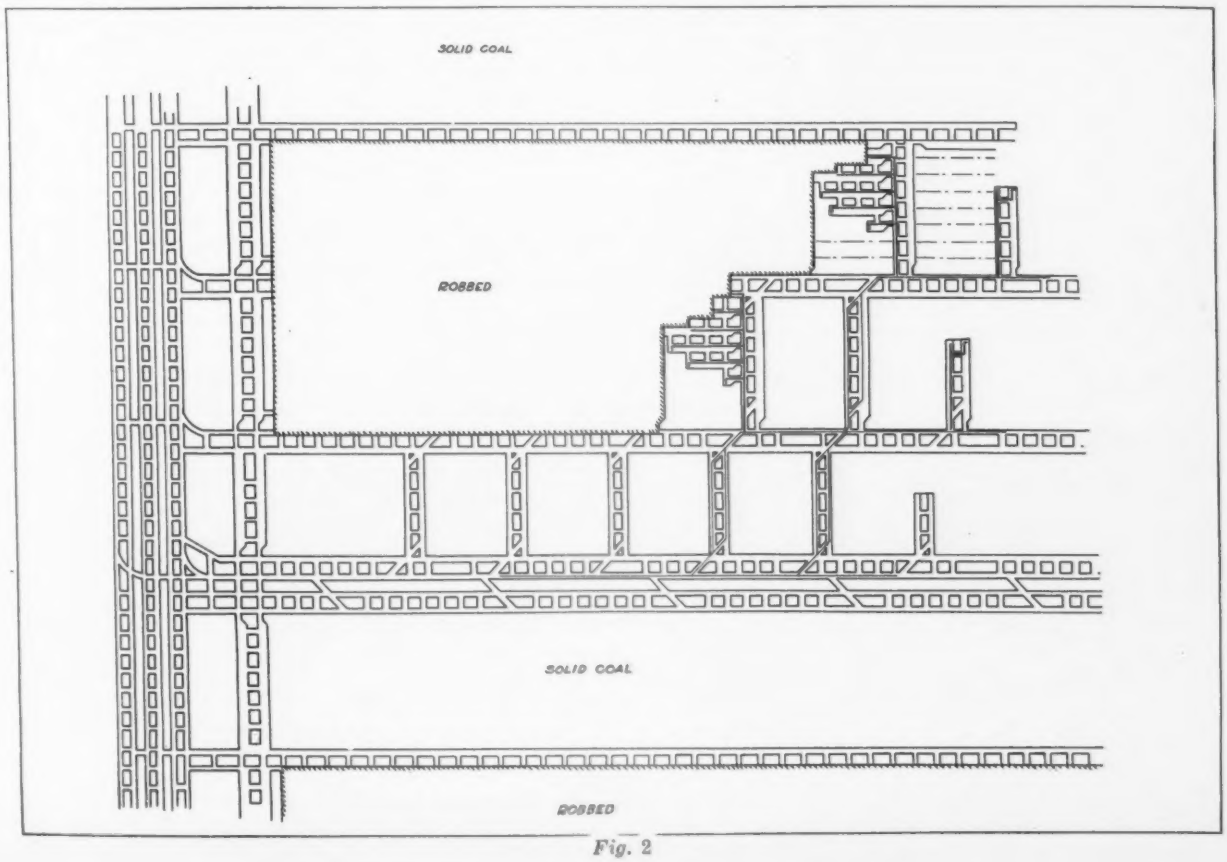


Fig. 2

"QUANTITY PRODUCTION" APPLIED TO MINING COAL

In The Application Of The Mining Systems Described In This Article The Writer Has Found That Their Success Is Predicated Upon Perfect Ventilation, Assured Roof Control, Continuous Operation Of Machinery And Minimum Heading Development

By R. Y. WILLIAMS *

IN the minds of many operating engineers the idea seems firmly fixed that the mining of coal, to align itself with the steel industry, the automobile industry and other industries which have made phenomenal strides through quantity production, must abandon adherence to the room and pillar method of mining. As extravagantly wasteful of labor as this room and pillar system is when all face operations are performed by hand, this waste becomes all the more pronounced when machines are introduced for cutting and loading the coal mechanically. Not infrequently, machinery introduced under the piecemeal conditions imposed by this method either fails to show profits or proves more costly than hand methods because usually only 20 percent of the full capacity of the machinery can be utilized.

As a result of the inadequacy of mechanical opportunity in the room and pillar system, there has been a real endeavor to experiment with the possibilities offered by mining on a longwall face. The various longwall systems may be separated into two groups—(a) "Advancing" long wall, wherein the coal mined on the long face is transported to the mine opening along haulage roads maintained through the exhausted territory by means of packwalls and roof brushing. This "advancing" system, in these days of high wages, becomes impracticable because of the high labor cost of maintaining transportation and ventilation passageways through the gob. And (b) "retreating" longwall, wherein the coal mined on the long face is transported to the mine opening through headings maintained in solid coal. This system does not require headings to be driven to the boundary of the property before any "retreating" face or faces can be started; rather, what it requires is that the mine workings be laid out in panels in which alternate panels accommodate the longwall faces as they are being advanced from the mine opening to the boundary, and the intermediate panels accommodate the longwall faces driven later from the boundary to the mine opening. In such a layout, the identical development headings used for transportation and ventilation in the advancing panels become the haulage roads and air courses of the retreating panels.

During the past two years we have been intensively studying existing modern mechanical methods of mining coal and designing systems for application under particular face conditions. In all of this work we have postulated as the prerequisites of these systems, perfect ventilation, assured roof control, continuous operation of machinery, and minimum heading development. Because of the success that has attended our introduction of metal jacks for controlling the roof along the longwall face and for causing it to break immediately back of the jacks after each advance, a request has come to me to indicate the most important consideration in the design and application of a new system to the conditions in a particular mine. My short answer may be as much of a surprise to the reader as it was to the editor; but it is made with great earnestness and is based not only on my own experience but on the observed experience of others.

To be completely successful in any business, and particularly in mining, a new system must be *thoroughly sold.*

In the first place; the man who is chosen from the organization, or who is called in from the outside, to be the father of the project, must be thoroughly sold on the possibilities of the new system. He must approach the point where his associates look upon him as a "nut" on the subject, equipped with a lock-washer to prevent any loosening of his hold on the question through discouragements. It goes without saying that this man (a) must be thoroughly acquainted with the nature and action of the immediate and main roof, the bed of coal, and the floor strata; (b) must have first hand knowledge of the outstanding attempts made by others to introduce longwall systems, whether these systems were successful or not; (c) must be a careful analyst in the matter of details, and just as able a synthesist in having the ability to put together details that will predicate a smooth working, well correlated, final plan of work, and (d) must submit his new system to the criticism of as many capable engineers as he can interest in the subject.

In the second place; it is presupposed that the owner or owners of the property (in cases, the Board of Directors) will have been informed as to the purposes of the new system, the possibilities of its success, the approximate cost of the necessary experimental work to determine its suitability to conditions, and the expected cutting (not merely shaving) of expenses. It should be remembered that the owner who is putting up the money for the necessary machinery of the test is entitled to full details, both of the plans to be undertaken and of the progress of the experiment.

And in the third place; men at the mine where the new system is to be tested should be carefully sold on the project, because their enthusiasm will be necessary to complete the success of the system. By "men at the mine" is meant not only officials and their assistants, but also face workers. This importance of a cordial attitude on the part of face workers is liable to be discounted except in the case of a man who has had previous actual experience in trying to install new methods and ideas in the mining of coal. The workman who is fully informed on the main details of the new system will realize the fact that he will share if it is successful, because bids for his future services will be raised above the basis of quotations on mere brawn.

If an entire company is thoroughly sold on a reasonably adequate system of longwall mechanical mining, that system is sure to give early indications of success; and if the enthusiasm of that company is sufficient to continue active through the secondary period of correcting and correlating the many details into a smoothly operating system, the results will be both extremely beneficial to that company's finances and of tremendous fundamental advantage to the industry as a whole.

*Weston Dodson & Co., Inc., Bethlehem, Pa.

FLUORSPAR IN 1925

Notwithstanding the large production of steel in 1925, the shipments of domestic fluorspar, according to the Bureau of Mines, Department of Commerce, amounted to only approximately 113,600 short tons, valued at about $2,052,000, decreases of 9 percent in quantity and 16 percent in total value as compared with 1924. The general average price per ton f. o. b. mines or shipping points for all grades in 1925 was $18.06, which is $1.55 less than the average for 1924. The shipments to manufacturers of glass and hydrofluoric acid were larger than in 1924, but smaller shipments were made to steel plants, foundries, and enamel and sanitary establishments. Exports of fluorspar, though small, were more than in 1924.

Fig. 1

Fig. 2

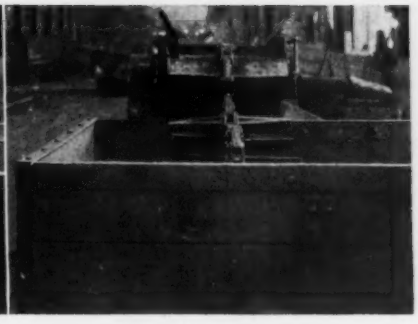


Fig. 3

INSTALLING AND MOVING ROOM CONVEYORS

The Three Conditions Which Must Be Considered In The Handling Of Room Conveyors Include Their Use In Rooms Loading At Face, In Taking Coal Away From The Face And For Slabbing In Rooms

By N. D. LEVIN*

THERE are three distinct conditions to consider in handling room conveyors; first, when used in rooms loading at the face, in which case the conveyor is lengthened as the room is being advanced, and when finished the entire conveyor has to be taken down and removed. The second condition is when the conveyor takes the coal away from a face conveyor, in which case a section at a time is taken off until the block is worked out, when only the head end and a few sections are left to be moved. In the latter case the full length of the conveyor is built up when the face conveyor is started on a new block. The third condition is when the conveyor is used for slabbing in a room. However if the first two operations are described, it covers the third.

Considering the first case; as soon as the room is driven a few feet, the driving end and a section are installed, and as each undercut is being loaded out, a section is added to the conveyor. It is not necessary to describe the manner of adding sections, as that is different in the various makes of conveyors, and if the conveyor is of a suitable design for underground work, it is a comparatively easy matter.

The entire conveyor can be taken down in many different ways, and much time and money can be wasted if it is not done in an orderly manner. Different conveyors will have to be handled in different ways, and I will here outline how the 47-A Jeffrey Sectional Conveyor should be taken down and set up.

TAKING DOWN

(1) Disconnect the chain at the head end.

(2) Place an empty car in front of the conveyor.

(3) Pull the chain out of the conveyor by means of the driving sprocket being run in the reverse direction. Pile up as much chain in the car as there is room for, then disconnect it. Move the car over a little more than the width of the flight, then put in another pile of chain, etc., until the whole chain is removed. See Fig. 2.

(4) A small truck made for the purpose, is now placed in the trough; the tail end loaded and transported by the truck, to the entry.

(5) Sections are now disconnected, loaded on the truck and transported in the same manner to the entry. See Fig. 1.

(6) When all of the sections have been removed, the head end is finally loaded on to a truck.

SETTING UP

If the conveyor is to be set up for taking coal away from a retreating face conveyor, the procedure is as follows:

(1) Set up the drive end at the entry.

(2) Place all of the bottom troughs and connect them together temporarily by putting in connecting links and pins as shown in Fig. 4. The truck is, of course, used in the bottom troughs for transporting the material.

(3) Bring in on the truck all of the top troughs and (*Continued on page* 297)

*Chief Engineer, Jeffrey Mfg. Co.

Fig. 4

Fig. 5

STANDARDIZATION OF DRILL STEEL

IN the conduct of its work the Committee on Drilling Machines and Drill Steel sent out a questionnaire to a large number of metal properties, the replies to which show that marked progress has been made by many companies in reducing the number of sections and sizes of drill steel. The following are the more important points brought out in the replies:

1. All companies except one (which uses a one -eighth-in. interval) are using a one-sixteenth-in. interval of bit diameter change.

2. One company has tried to use a one-thirty-second-in. bit change in interval and reports that it was not practicable.

3. All companies have done away with, or are planning to do away with, dry machines and solid sections of steel. (They state that sprays are ineffective and unsuccessful.) This change is bound to have a beneficial effect upon the health of the miners.

4. Lugged and collared steel breakage excessive with hand-rotated stopers, but with self-rotated stopers breakage not serious. Tendency toward use of more self-rotated stopers.

5. Everyone agrees that the fewer sections the lower the total cost of steel, steel handling, and steel sharpening.

6. Although several companies are using from three to five kinds of steel, all agree that they can, and eventually will, standardize on only two kinds, and three companies have decided to standardize on only one kind.

7. The sections and sizes most companies are willing to eliminate are 1 in. cruciform solid, 1¼-in. cruciform solid, 1⅛-in. round hollow, 1⅛-in. hexagon hollow, 1-in. hexagon hollow, and seven eighths in. hexagon hollow.

8. Several companies using both seven-eighths in. quarter octagon hollow and seven-eighths in. hexagon hollow state that they could drop the seven-eighths-in. hexagon hollow.

9. Of the three companies which have decided on only one kind of steel for all uses, two companies have chosen 1-in. round hollow and one company has chosen seven eighths-in. quarter octagon hollow.

10. Companies having exceedingly hard rock and companies drilling very long holes (over 10 feet) have in most every case stated that a heavy steel is necessary. They have chosen, in all cases, 1¼-in. round hollow as their heavy steel and either seven-eighths-in. quarter octagon hollow or 1-in. round hollow as a lighter steel for softer ground.

11. The most interesting point brought out was the fact that only *three* kinds of steel will take care of all the companies' requirements when they have completed their standardization program. These are 1¼-in. round hollow, 1-in. round hollow, seven-eighths-in. quarter octagon.

This shows that a great deal has been done by most companies in the Southwest toward standardization. It is almost certain that each one of the above-mentioned sections has very marked advantages for certain kinds of work, and it is doubtful if any one of these sizes or sections could be eliminated without seriously affecting the drilling costs of certain companies. On the other hand, it appears very possible that the mining industry could get together on these three, or not more than four or five, sizes and shapes of steel. If this can be done the steel companies would have fewer sections to roll and keep on hand, which should mean more volume of each kind rolled and lower total stocks of steel kept on hand. These reductions should ultimately be reflected in lower prices of drill steel. During the coming year we will refer this matter to each member of the committee and have his definite recommendation.

A very common statement in the questionnaires was that different companies intend to standardize on one or two sections of steel "as soon as present stocks in their mines and supply departments are exhausted."

Standardizing on one or two sections of steel involves the following procedure:

1. Changing machine chucks.
2. Changing sharpening dies.
3. Utilizing stock of other sections of steel on hand.

The method used at the Pilares mine of the Moctezuma Copper Co. of dropping five kinds of steel and in a comparatively short period of time standardizing on only one may be of interest. Simultaneous with the change to one drill steel the use of all dry stopers and of all heavy drifting machines was discontinued. The heavy drifters were sold or scrapped and the dry stopers changed to wet stopers.

Machine Chuck Changes

First the chucks of all machines on one level were changed to take 1-in. round hollow steel. This was done at small expense as follows:

1. *C. C. W.* 11 *Ingersoll-Rand Stopers with seven-eighths-in. Hexagon Chucks.*

Seven-eighths in. hexagon chucks were drilled out to fit 1-in. round steel and the chucks were slotted on two sides to allow the shank lugs to enter. In this manner all seven-eighths-in. chucks on the machines and in stock were converted to 1-in. chucks at small expense.

2. *C. C.* 11 *Ingersoll-Rand Stopers with 1-in. Cruciform Chucks.*

Chucks were bored for 1-in. round steel as was done with seven-eighths-in. hexagon chucks described above.

3. *Seventy-three W Waugh Stoper.*

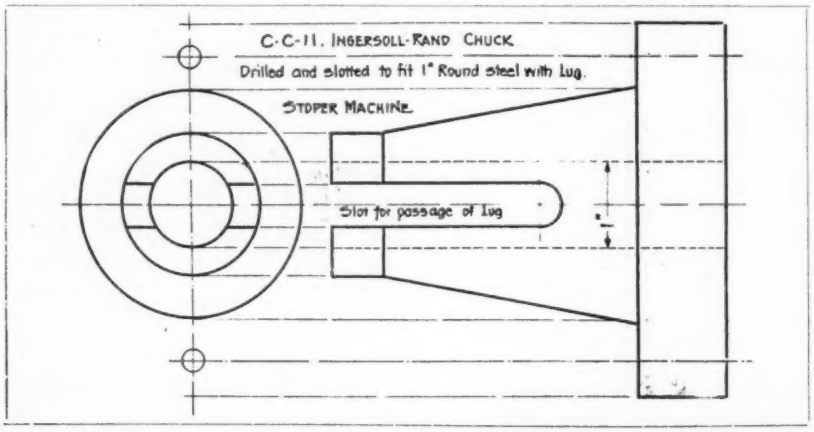
The chuck bushings were removed and slotted in same manner described above.

4. *Fifty - Fifty-five Clipper — Waugh Plugger.*

(Used unmounted for shaft sinking and plugging and mounted for drifting.) New chucks were ordered to fit 1-in. steel as old ones were worn out.

5. *Ninety-three Waugh.* (Use same as 50-55 Clipper.)

Being only a few of these on trial, it was necessary to make two home-made parts so Clipper front end with 1-in. round chuck could be placed on this machine. This was done to speed up conversion to 1-in. steel and was necessary because at that time the manufacturers had not started making 1-in. round chucks for this machine.



Drill Sharpener Changes

DOLLIES

No changes were necessary, as the dollies for each gauge were the same. It was found, however, that by sharpening hollow steel with dry instead of wet dollies the number of plugged steel was materially decreased. The principle involved is nothing more than closing up

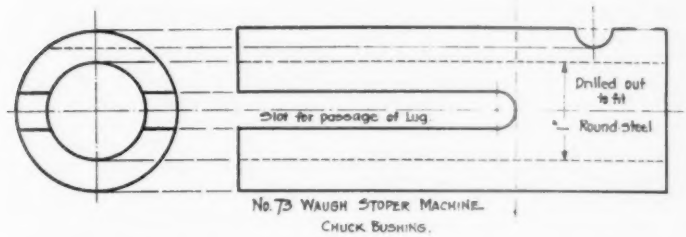


Fig. 2

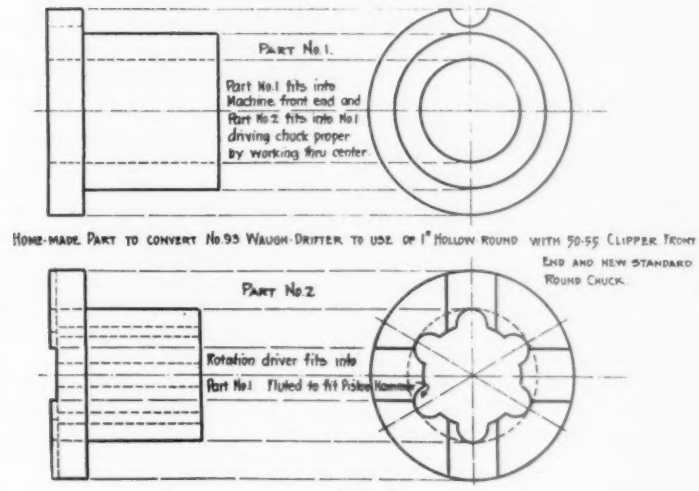

Part No. 1.
Part No. 1 fits into Machine front end and Part No. 2 fits into No. 1 driving chuck proper by working thru center.
Home-made Part to convert No. 93 Waugh-Drifter to use of 1" Hollow Round with 50-55 Clipper Front End and new Standard Round Chuck.
Part No. 2
Rotation driver fits into
Part No. 1 Fluted to fit Piston Hammer

Fig. 3

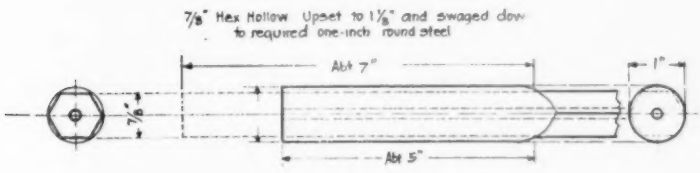


Fig. 4

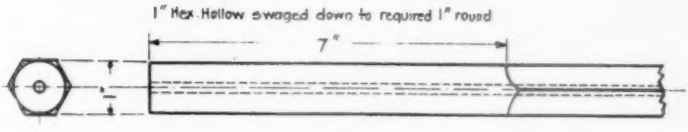


Fig. 5

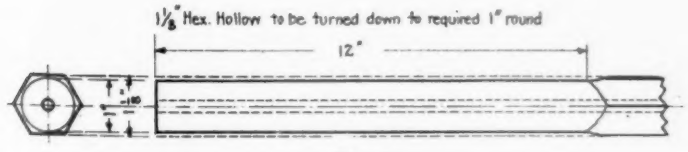


Fig. 6

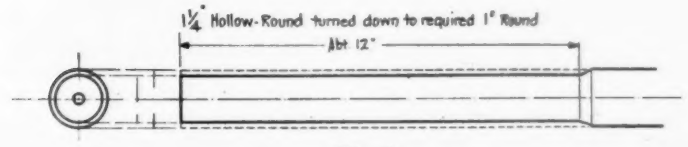


Fig. 7

the hole in the bit to a diameter smaller than the diameter of the hole through the steel so in case any particles of cuttings do pass through the bit end they will not lodge and pack but pass on through the steel. This does not entirely eliminate plugged steel but decreases it over 60 percent, and in case the steel does plug, the plug will be a short and softer one near the bit, where it can be easily cleared out.

Sharpening Dies

Seven-eighths-In. Hexagon Dies:

1. Annealed by heating to dull red color and leaving in lime for two days.
2. Bored out to 1-in. round size.
3. Heated to dull red and plunged in tempering oil.

1-In. Cruciform Dies:

As these were round, no change had to be made.

1-In. Hexagon Dies:

1. Top and bottom half put together with a one thirty-second by three-fourth in. shim on each side (to give the dies the necessary grab when sharpening), and the space between welded full with "Polished Drill Steel Welding Rod," made by the Crucible Steel Co.—this welding rod takes a temper.
2. Dies bored out to 1-in. round size.
3. Heated to dull red and plunged in tempering oil.

1⅛-In. Hexagon Dies:
1⅛-In. Round Dies:
1¼-In. Round Dies:

Converted to 1-in. round dies by same method described for 1-in. hexagon dies.

These dies are most satisfactorily welded with an electric welder. The same scheme works very well for reclaiming dies which are worn out.

Converting Different Sections of Drill Steel for Use in Standard Machine Chuck

Seven-eighths-In. Hexagon Hollow:

Over 30 tons of this steel were changed to fit 1-in. round machine chucks, as follows:

1. First 7 inches of shank end of steel were heated to 1,500° F.
2. End upset to 1⅛-in. diameter in Waugh punch.

In doing this the pin which penetrates the hole in the shank is held in the punch tappet and the punch tappet allowed to strike and upset the end of the steel.

3. Steel reheated.
4. End of steel swaged down in Sullivan sharpener to 1-in. standard round. Before doing this a one-fourth by 8-in. round pin is driven into hole to keep it open.
5. Shank the steel which now has a 1-in. end in the regular manner used for putting on the lugs.

1-*In Hexagon Hollow:*

1. Seven inches on shank end heated to 1,500° F.

2. Shank swaged down in Sullivan sharpener to 1-in. standard round, the hole being kept open by a pin.

3. Standard 1-in. round shank with lugs put on in regular manner.

1⅛-*In. Hexagon Hollow:*

1. Twelve inches on shank end turned down to diameter of 1 inch.

2. Standard 1-in. round shank with lugs put on in regular manner. It was found that this steel was too heavy for long lengths, and its use was confined to starters and seconds only.

1⅛-*In. Round Hollow:*

Same procedure as for 1⅛-in. hexagon hollow.

1¼-*In. Round Hollow:*

Same procedure as for 1⅛-in. hexagon hollow.

This steel was so exceedingly heavy that only starters could be used with 1-in. round shanks. There was little difficulty selling the entire stock of this steel to other companies who have standardized on 1¼-in. round hollow.

1-*In. Cruciform Solid:*

The percent breakage of this section of steel was exceedingly high (10 percent to 15 percent). A few dry stopers on the upper levels, which were the last levels to be changed over to standard machines and steel, soon broke up and exhausted the supply on hand.

Most of the schemes outlined above for standardizing on fewer machines and sections of steel in a comparatively short time without scrapping equipment on hand were developed by Messrs. Wash McLean, A. Y. Smith, and E. W. Bitticks. They are given in detail with the hope that they may serve as suggestions to others contemplating a change to fewer sections of steel.

I quote from letter of Mr. Gerald Sherman, consulting engineer, Mining Department, Phelps Dodge Corporation, has very kindly written on the subject of standardization:

"The principal advantage of standardization is to redure the quantity of steel necessarily in use and to assist in steel distribution.

"The cross-section of steel now in use is generally confined to round and quarter octagon. The quarter octagon has the advantage that it can be rotated without the necessity of providing lugs, as compared with round, and of providing more wearing surface as compared with hexagonal steel. Its disadvantages are that, from the method of manufacture, it generally has a less perfect hole than the round steel and, through lack of as much working in the rolls, probably is of little poorer quality than the round section.

"While quarter octagon has the advantage of not having to form either collar or lug and thus decreasing the cost of preparing it for use as well as reducing the percentage of breakage, it has the disadvantage that a tappet must be used in the machine, which cuts down the drilling speed from 10 to 12 percent and provides no easy method of extraction from the hole if it sticks.

"It seems probable to me that there is not much difference between collars or lugs in causing steel breakage. With quarter octagon steel the resistance to rotation is also greater than in the round section.

"It has been found that lengthening the chuck has a great influence on reducing the breakage of steel, and some companies are now getting stoping machines with longer chucks. I am also told that the use of self-rotating stopers has also reduced the breakage still further. In the use of jackhammers it has been found that increasing the length of the chuck, which must be done in order to use lug steel, has improved the behavior of the jackhammer considerably when held in the hand. It aligns itself better with the hole and rotates more easily.

"Chuck wear has great influence on breakage, and its effect is also reduced by lengthening the socket.

"When we come to the selection of a particular brand of steel, I doubt if we have much information of value to give you. The difference in hardness between different pieces of steel of the same brand sharpened and tempered by the same man is great enough to make me feel that it would be difficult to show small differences in results between two kinds of steel without much more elaborate tests than we have as yet made. Big differences could be determined without much trouble."

I wish to thank the officials of the different companies who were so kind as to send in descriptions of their practice and to give us their ideas on standardization.

Report submitted by Frank Ayer, *Chairman*, Committee on Drilling Machines and Drill Steel, National Standardization Division, the American Mining Congress.

The complete record of the public hearing held in Washington on February 10 and 11 before the Federal Oil Conservation Board, appointed by the President to recommend national petroleum policies, is now available from the Superintendent of Documents, Government Printing Office, Washington, for 25 cents a copy, upon reference to "Federal Oil Conservation, Complete Record of Public Hearings."

STANDARDIZING MINE VENTILATION

(*Continued from page* 256)

of coal mined and height lifted. Assume a case where the daily output of material is 5,000 tons raised from the 1,000-foot level. The theoretical energy to lift this weight, neglecting that of acceleration, is 5,000 x 1,000 = 5,000,000 foot-tons. Assume that the air required to ventilate this mine is 200,000 c. f. m. at 3 inches w. g. If the fans were operated continuously the weight of air passing through them in the course of a day would amount to 10,800 tons. The power required to circulate this air, disregarding fan efficiency, is 200,000 x 5.19 x 3 = 3,120,000 foot-pounds per minute which in a day's time will represent 2,250,000 foot-tons of work. We have, then, in this case about twice the weight of air moved as coal with about half the work. The largest factor in changing this proposition is probably the depth of shaft. In any event, a large amount of energy is used to move the air through a mine and every effort should be made to conserve this energy.

Another misconception often exists over the difference in flow conditions when blowing and exhausting. In effect, there is no difference if the air flow is in the same direction, except so far as the ventilating currents may be modified by leakage of gas or air into or from seams and fissures. Imagine a stream of air entering a room as in figure 3 and leaving by a discharge pipe as shown. It will not matter whether the air is blown into the room at "A" or exhausted at "B," the flow will be the same and very much as indicated by the arrows. But if the air current is reversed, that is, flows in at "B" and out at "A," the flow conditions in the room will be quite different. Air leaving a room under pressure flows out rather uniformly from all sides unless badly disturbed conditions exist; while air entering a room which is under less pressure, persists in the direction of flow until its velocity energy is dissipated. A careful study of this one principle, so well exemplified in the flow through a simple orifice, will be a valuable aid in any ventilating work.

The department of mines and mining of the Sacramento Chamber of Commerce protested against the bill of the forest service to restrict mining in national forests. It says that this bill is a great menace to the western mineral industry and will strangle prospecting, as the bulk of mineralized lands are in national forests, and declares that existing forest regulations are burdensome to prospectors and miners.

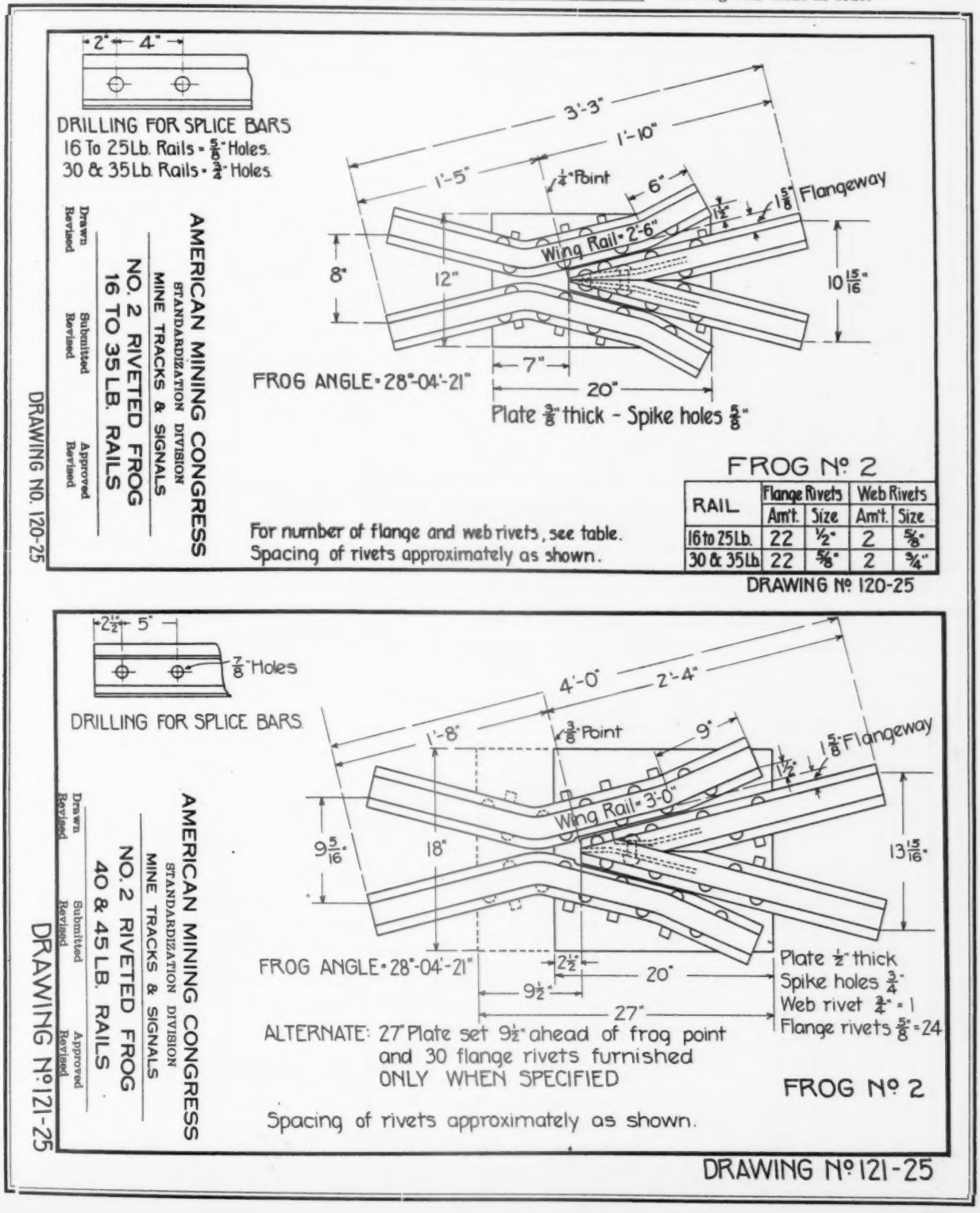
PROPOSED COAL MINE TRACKS AND SIGNALS STANDARDS

Foreword

1. As the standardization of trackwork can be made very definite, and as full details are necessary, the recommendations for frogs and switches are shown by 33 drawings. The drawings are numbered by hundreds and divided as follows:

Section	
No. 1—Riveted frogs	100
No. 2—Cast frogs	200
No. 3—Switches	300
No. 4—Guard rails	400
No. 5—Turnouts	500
No. 6—Switch stands	600

2. For an understanding of the drawing groups, let it be stated that Nos. 120-25, 121-25, etc., cover riveted frogs. Drawings 200-25 and 201-25 cover cast frogs, while 300-25, 301-25, etc., show switches or switch fixtures. The lone number 25 in each case signifies the drawing was made in 1925.



3. The 20 in 120 and the 21 in 121 is for No. 2 frogs as covered by the figure 2 in 120, while the figure 3 in the 130 group signifies No. 3 frog, etc. For switches the first figure 3 in, say, 350-25, signifies a switch drawing, while the 5 in 50 indicates a 5-foot switch.

4. The drawing groups being now explained we pass on to the recommendations for standards.

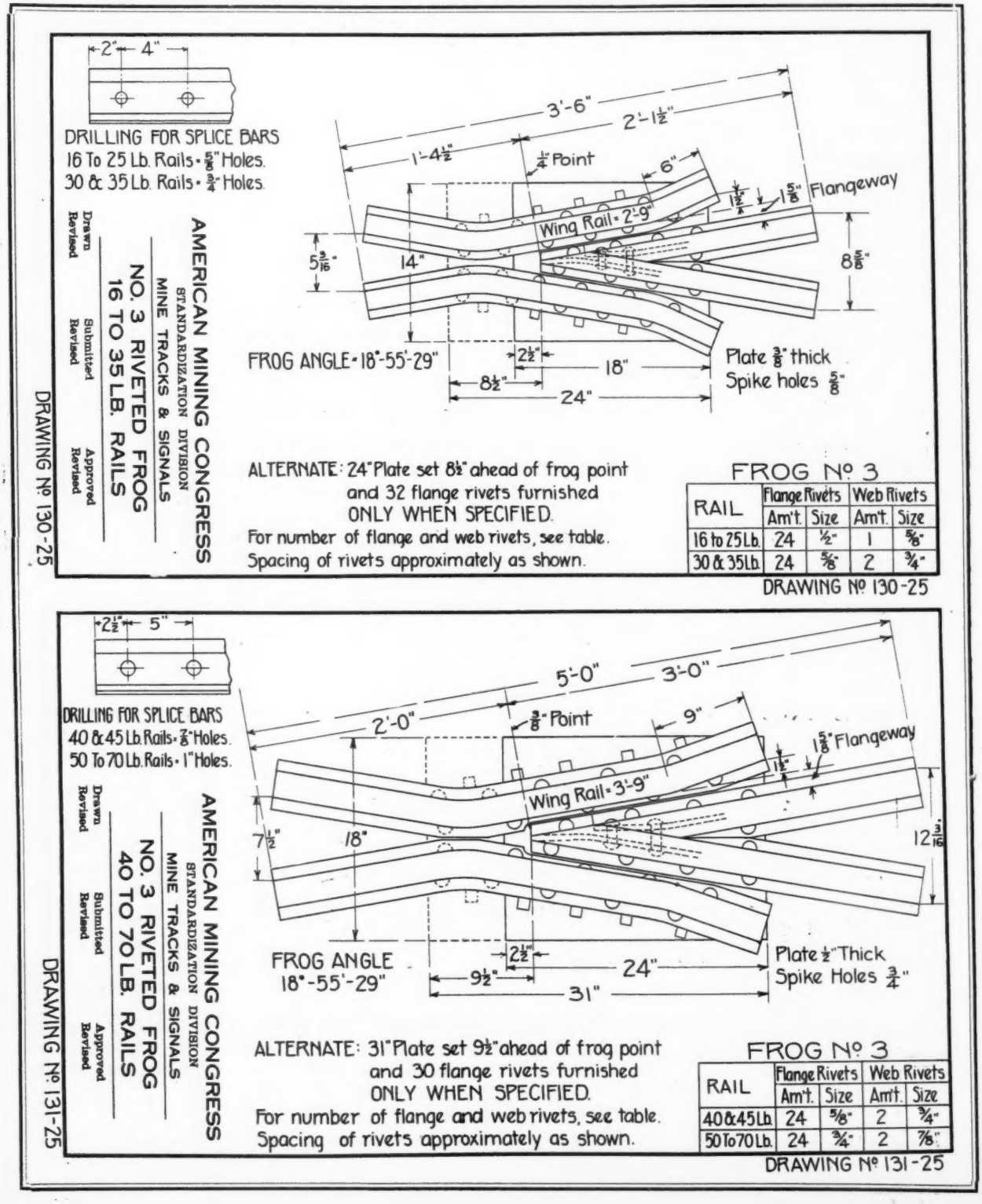
Gage:

5. The standard track gage shall be 42 inches.

6. The adoption of this dimension is based on the fact that the number of mines actually using it is greater than any other. A 42-inch gage forms the best radii of curves with useful frog angles to suit the majority of coal-mine work.

7. Under certain conditions, such as demands the use of cars to meet low-roof mines, etc., a gage of 42 inches may be prohibitive, and if necessary that it be other than standard the alternates shall be in steps of 6 inches above or below, such as 30, 36, or 48 inches.

8. In addition to the above an extra alternate of 4'-8½" gage is allowed, as some mines find it an advantage to have equipment that will roll on standard railroad tracks.



9. Any other alternate shall not be considered, as the intention is to simplify and standardize not only the track itself but also the rolling equipment, such as locomotives and cars. Regardless of the alternates, the standard gage of 42 inches shall be used whenever possible.

Rail:

10. The rails covered by these standards shall be from 16 to 70 lbs. per yard, inclusive, with room tracks limited to 45 lbs. and below.

Drilling:

11. The drilling of rails or spacing and size of holes for splice bars shall be as follows:

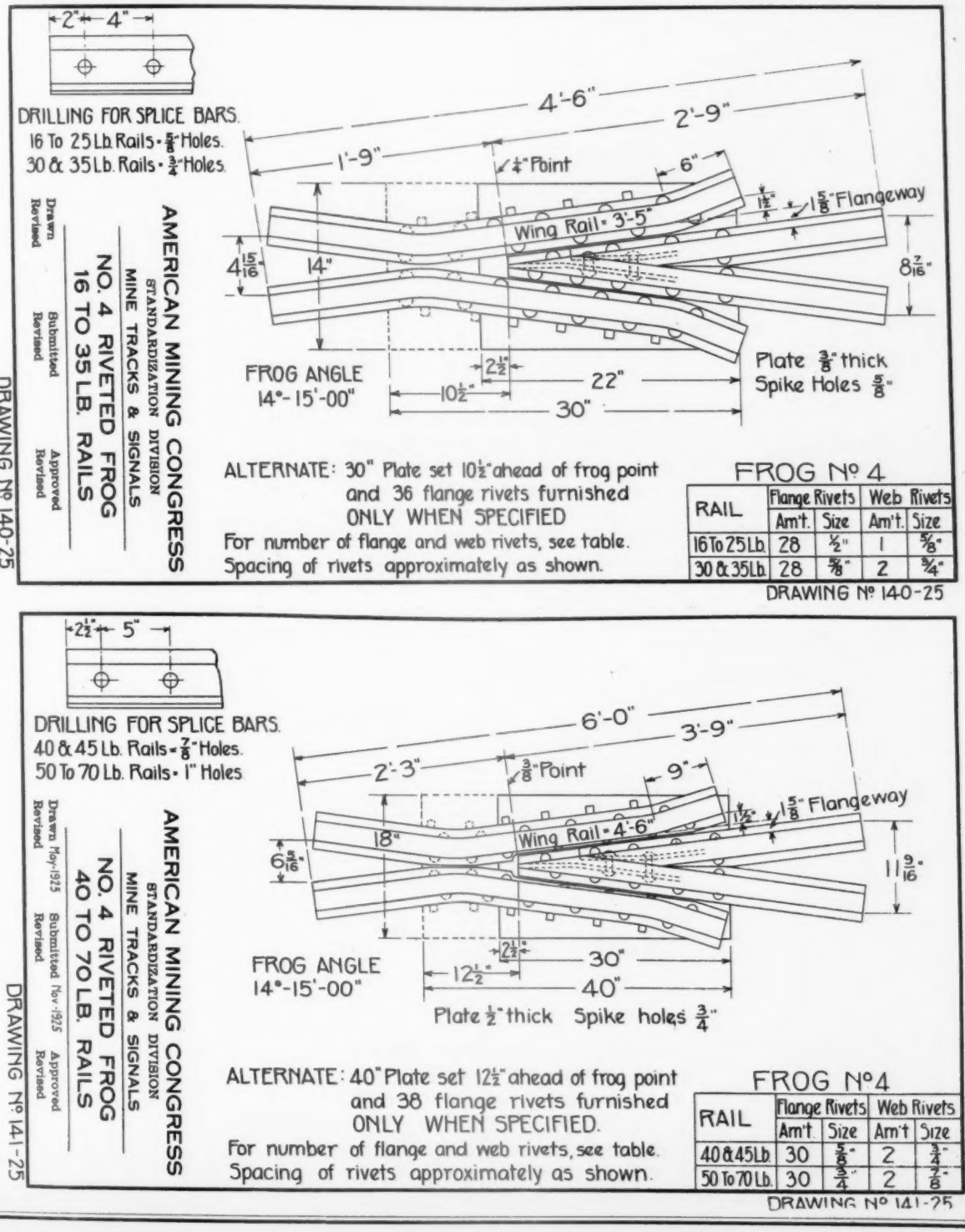
Rails	Spacing	Diameter of holes
16 to 25 lb.	2 x 4"	5/8"
30 and 35 lb.	2 x 4"	3/4"
40 and 45 lb.	2½ x 5"	7/8"
50 to 70 lb.	2½ x 5"	1"

12. In the spacing given the first dimension is the distance from end of rail to center of first hole, and the second dimension is the distance from center of first to center of second hole. These drilling dimensions are plainly shown on all frog and switch drawings.

Frog Numbers (Angles):

13. Standard frog numbers and angles shall be as follows:

	Angle
No. 2	28° 04'—21"
No. 3	18° 55'—29"
No. 4	14° 15'—00"
No. 5	11° 25'—16"
No. 6	9° 31'—38"



FROG Nº 4

RAIL	Flange Rivets		Web Rivets	
	Am't.	Size	Am't.	Size
16 To 25 Lb.	28	1/2"	1	5/8"
30 & 35 Lb.	28	5/8"	2	3/4"

DRAWING Nº 140-25

FROG Nº 4

RAIL	Flange Rivets		Web Rivets	
	Am't.	Size	Am't	Size
40 & 45 Lb.	30	5/8"	2	3/4"
50 To 70 Lb.	30	3/4"	2	7/8"

DRAWING Nº 141-25

14. No. 2 frog is for room turnouts.

15. No. 3 frog is for turnouts between room entries and face or panel entries.

16. No. 4 frog is for turnouts between face and panel entries and in some cases for main haulage.

17. Nos. 5 and 6 frogs are for turnouts for main-line haulage only, and especially where traffic is fast.

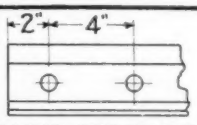
Frogs—Riveted:

18. Riveted frogs are covered by drawings as listed below:

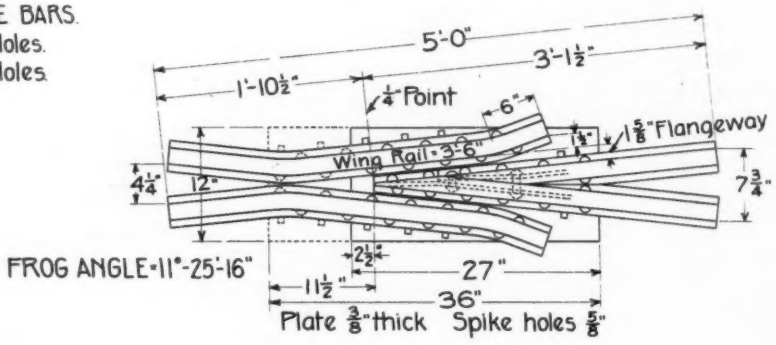
	Draw.
No. 2 frog, 16 to 35 lb. rail	120-25
No. 2 frog, 40 & 45 lb. rail	121-25
No. 3 frog, 16 to 35 lb. rail	130-25
No. 3 frog, 40 to 70 lb. rail	131-25
No. 4 frog, 16 to 35 lb. rail	140-25
No. 4 frog, 40 to 70 lb. rail	141-25
No. 5 frog, 16 to 35 lb. rail	150-25
No. 5 frog, 40 to 70 lb. rail	151-25
No. 6 frog, 16 to 35 lb. rail	160-25
No. 6 frog, 40 to 70 lb. rail	161-25

19. The No. 2 frog is included by rails 16 to 45 lb. only, as this range of rails is listed above as the limit for rooms. The No. 2 frog being only for room turnouts is consequently not included with rails heavier than 45 lbs.

20. Details of frogs shall be as shown on drawings. The length over all, as well as toe and heel distances, being such as to present a minimum and still allow free use of splice bars without interference and consequent necessary trimming



DRILLING FOR SPLICE BARS.
16 To 25 Lb. Rails = $\frac{5}{16}$" Holes.
30 & 35 Lb. Rails = $\frac{3}{4}$" Holes.



ALTERNATE: 36" Plate set 1½" ahead of frog point and 40 flange rivets furnished ONLY WHEN SPECIFIED.

For number of flange and web rivets, see table Spacing of rivets approximately as shown.

FROG Nº 5

RAIL	Flange Rivets		Web Rivets	
	Am't.	Size	Am't	Size
16 To 25 Lb.	32	½"	2	⅝"
30 & 35 Lb.	32	⅝"	2	¾"

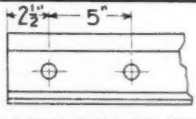
DRAWING Nº 150-25

AMERICAN MINING CONGRESS
STANDARDIZATION DIVISION
MINE TRACKS & SIGNALS

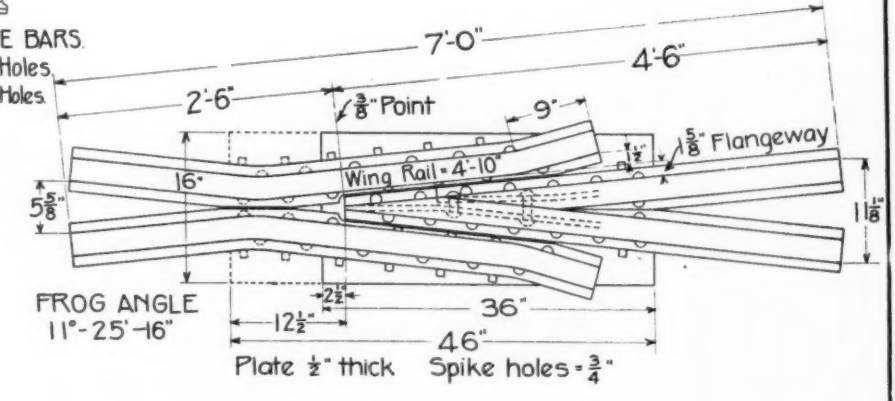
NO. 5 RIVETED FROG
16 TO 35 LB. RAILS

Drawn May 1925 Revised
Submitted Nov 1925 Revised
Approved Revised

DRAWING Nº 150-25



DRILLING FOR SPLICE BARS.
40 & 45 Lb. Rails = ⅞" Holes.
50 To 70 Lb. Rails = 1" Holes.



ALTERNATE: 46" Plate set 12½" ahead of frog point and 42 flange rivets furnished ONLY WHEN SPECIFIED

For number of flange and web rivets, see table. Spacing of rivets approximately as shown.

FROG Nº 5

RAIL	Flange Rivets		Web Rivets	
	Am't.	Size	Am't.	Size
40 & 45 Lb.	34	⅝"	2	¾"
50 To 70 Lb.	34	¾"	2	⅞"

DRAWING Nº 151-25

AMERICAN MINING CONGRESS
STANDARDIZATION DIVISION
MINE TRACKS & SIGNALS

NO. 5 RIVETED FROG
40 TO 70 LB. RAILS

Drawn May 1925 Revised
Submitted Nov 1925 Revised
Approved Revised

DRAWING Nº 151-25

of these parts of trackwork. With the length as a fixture, other details have been fixed accordingly and shall be as shown on the drawings.

Frogs—Cast:

21. Cast frogs are covered by drawings as listed below:

	Drawing
16 to 35 lb. rails	200-25
40 to 70 lb. rails	201-25

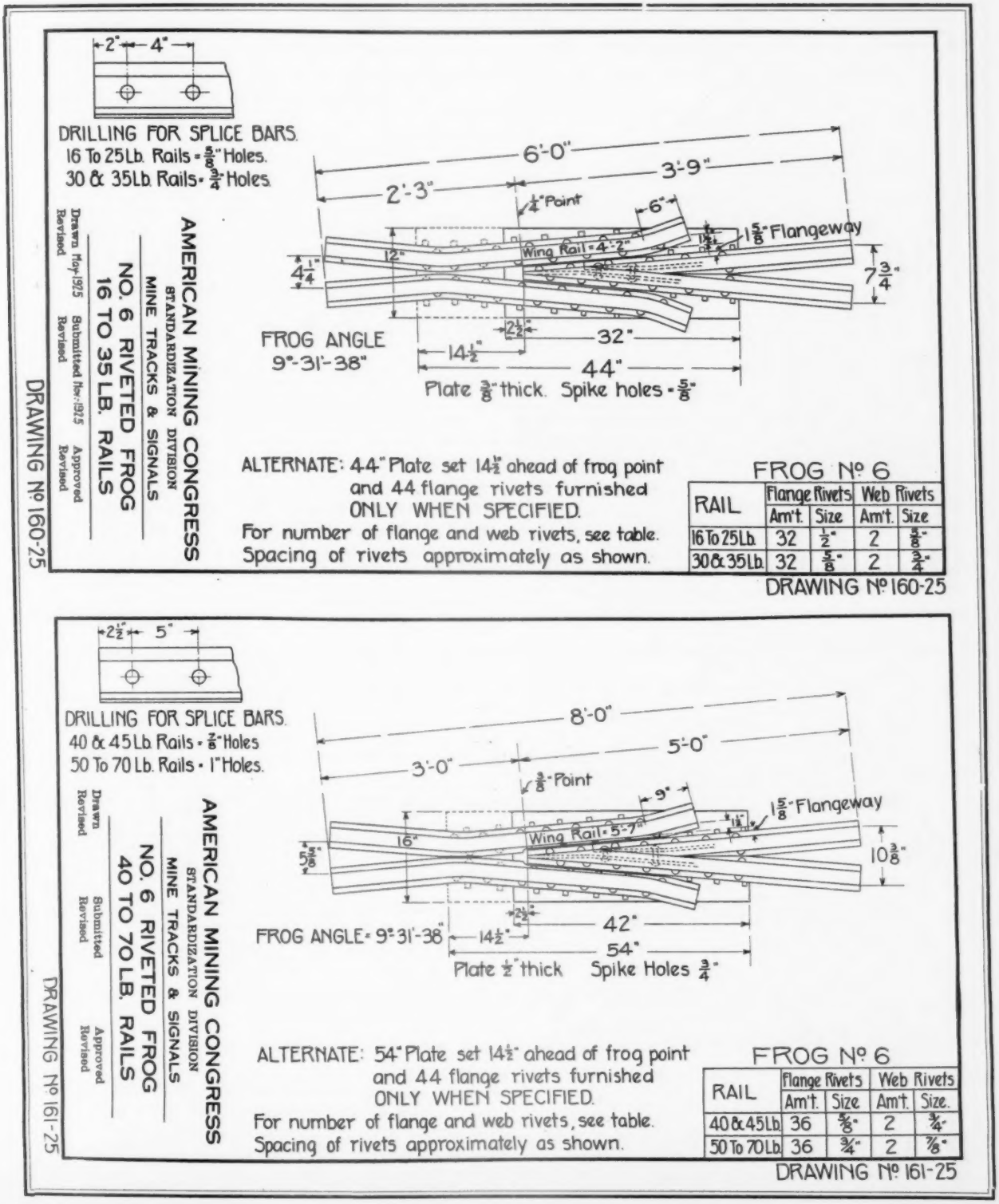
22. All numbers or angles are included in each of the two divisions of rail. No certain design is proposed, but definite dimensions for length over all, toe and heel lengths and spreads, shall be as listed on the drawings.

23. As in riveted frogs, the No. 2 frog is not included for rails above 45 lbs.

Switch Lengths:

24. Lengths of switches and the number of frog with which they are to be used shall be as follows:

3'-6" switch for use with No. 2 frog .
5'-0" switch for use with Nos. 3 and 4 frogs
7'-6" switch for use with Nos. 5 and 6 frogs



FROG No 6

RAIL	Flange Rivets		Web Rivets	
	Am't.	Size	Am't.	Size
16 To 25 Lb.	32	1/2"	2	5/8"
30 & 35 Lb.	32	5/8"	2	3/4"

DRAWING No 160-25

FROG No 6

RAIL	Flange Rivets		Web Rivets	
	Am't.	Size	Am't.	Size.
40 & 45 Lb.	36	5/8"	2	3/4"
50 To 70 Lb.	36	3/4"	2	7/8"

DRAWING No 161-25

Switch Heel Spreads:

25. Heel spreads of switches shall be such as to present the sharpest angle and still allow room for spike holes in heel plates. The spreads are governed by size of rail and not by lengths of switches and shall be as listed below:

	Heel spread
16 to 45 lb. rails	4½"
50 to 60 lb. rails	5"
65 and 70 lb. rails	5½"

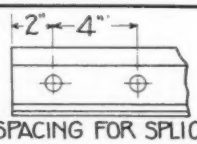
Switch Types:

26. Switches shall be of two types, light and heavy duty. The light duty switch shall be only for rails from 16 to 35 lbs. and lengths of 3' 6" and 5' 0" as shown on drawings 330-25 and 350-25. All other switch drawings cover the heavy duty type.

Switch Details:

27. The complete switches shall be as shown on accompanying drawings:

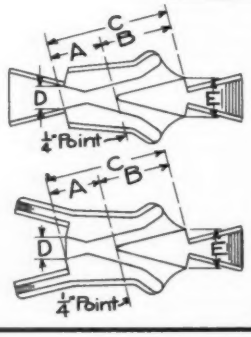
Length	Rail	Duty	Drawing
3'-6"	16 to 35 lbs.	Light	330-25
3'-6"	16 to 35 lbs.	Heavy	331-25
3'-6"	40 & 45 lbs.	Heavy	332-25
5'-0"	16 to 35 lbs.	Light	350-25
5'-0"	16 to 35 lbs.	Heavy	351-25
5'-0"	40 & 45 lbs.	Heavy	352-25
5'-0"	50 to 60 lbs.	Heavy	353-25
5'-0"	65 & 70 lbs.	Heavy	354-25
7'-6"	16 to 35 lbs.	Heavy	370-25
7'-6"	40 & 45 lbs.	Heavy	371-25
7'-6"	50 to 60 lbs.	Heavy	372-25
7'-6"	65 to 70 lbs.	Heavy	373-25



BOLT SPACING FOR SPLICE BARS.
16 To 25 Lb. Rail - ½" Bolts.
30 & 35 Lb. Rail - ⅝" Bolts.

RAIL		16 Lb.		20 Lb.		25 Lb.		30 Lb.		35 Lb.	
E		4"		4¼"		4½"		5"		5¼"	
FROG NO.	A	B	C	B	C	B	C	B	C	B	C
2	6 11/16"	7 3/4"	14 7/16"	8 1/4"	14 15/16"	8 3/4"	15 7/16"	9 13/16"	16 1/2"	10 5/16"	17"
3	8 3/8"	11 7/16"	19 13/16"	12 3/16"	20 9/16"	12 15/16"	21 5/16"	14 7/16"	22 13/16"	15 3/16"	23 9/16"
4	11 1/16"	15 1/8"	2'-2 3/16"	16 1/8"	2'-3 3/16"	17 1/8"	2'-4 3/16"	19 1/8"	2'-6 3/16"	20 1/8"	2'-7 3/16"
5	13 13/16"	18 7/8"	2'-8 11/16"	20 1/8"	2'-9 15/16"	21 3/8"	2'-11 3/16"	23 7/8"	3'-1 11/16"	2'-1 3/8"	3'-2 13/16"
6	16 9/16"	22 9/16"	3'-3 1/8"	2'-0 1/16"	3'-4 5/8"	2'-1 9/16"	3'-6 1/8"	2'-4 5/8"	3'-9 1/16"	2'-6 7/8"	3'-10 11/16"

"D" = 3" For Frog No. 2 2½" For Frogs No. 3, 4, 5 & 6.



The A.M.C. STANDARD for cast frogs applies ONLY to the dimensions given. Two styles of frogs are shown herewith but the selection of either, or any other design, rests with the user.

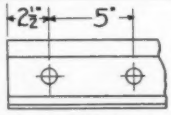
AMERICAN MINING CONGRESS
STANDARDIZATION DIVISION
MINE TRACKS & SIGNALS

CAST STEEL FROG
16 TO 35 LB. RAILS

Drawn May 1925 Submitted Nov 1925
Revised Revised
Revised Approved

DRAWING No. 200-25

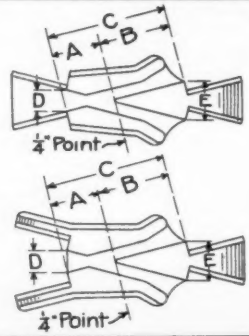
DRAWING 200-25



BOLT SPACING
FOR SPLICE BARS.
Bolts - ¾" Diam.

RAIL		40 Lb.		45 Lb.		50 Lb.		55 Lb.		60 Lb.		65 Lb.		70 Lb.	
E		5½"		6"		6¼"		6½"		6¾"		7"		7¼"	
FROG NO.	A	B	C	B	C	B	C	B	C	B	C	B	C	B	C
2	6 11/16"	10 13/16"	17½"	11 7/8"	18 9/16"										
3	8 3/8"	15 15/16"	2'-0 5/16"	17½"	2'-1 7/8"	18 1/4"	2'-2 5/8"	19"	2'-3 3/8"	19 3/4"	2'-4 1/8"	20 9/16"	2'-4 15/16"	21 5/16"	2'-5 11/16"
4	11 1/16"	21 3/16"	2'-8 1/4"	23 3/16"	2'-10 1/4"	2'-0 9/16"	2'-11 1/4"	2'-1 3/16"	3'-0 1/4"	2'-2 3/16"	3'-1 1/4"	2'-3 1/4"	3'-2 5/16"	2'-4 1/4"	3'-3 5/16"
5	13 13/16"	2'-2 3/8"	3'-4 3/16"	2'-4 7/8"	3'-6 11/16"	2'-6 1/8"	3'-7 15/16"	2'-7 7/16"	3'-9 1/4"	2'-8 11/16"	3'-10 1/2"	2'-9 15/16"	3'-11 3/4"	2'-11 3/16"	4'-1"
6	16 9/16"	2'-7 5/8"	4'-0 3/16"	2'-10 5/8"	4'-3 3/8"	3'-0 1/8"	4'-4 11/16"	3'-1 5/8"	4'-6 3/16"	3'-3 1/8"	4'-7 11/16"	3'-4 5/8"	4'-9 3/16"	3'-6 1/8"	4'-10 11/16"

"D" = 3" For Frog No. 2 2½" For Frogs No. 3, 4, 5 & 6.



The A.M.C. STANDARD for cast frogs applies ONLY to the dimensions given. Two styles of frogs are shown herewith but the selection of either, or any other design, rests with the user.

AMERICAN MINING CONGRESS
STANDARDIZATION DIVISION
MINE TRACKS & SIGNALS

CAST STEEL FROG
40 TO 70 LB. RAILS

Drawn May 1925 Submitted Nov 1925
Revised Revised
Revised Approved

DRAWING No. 201-25

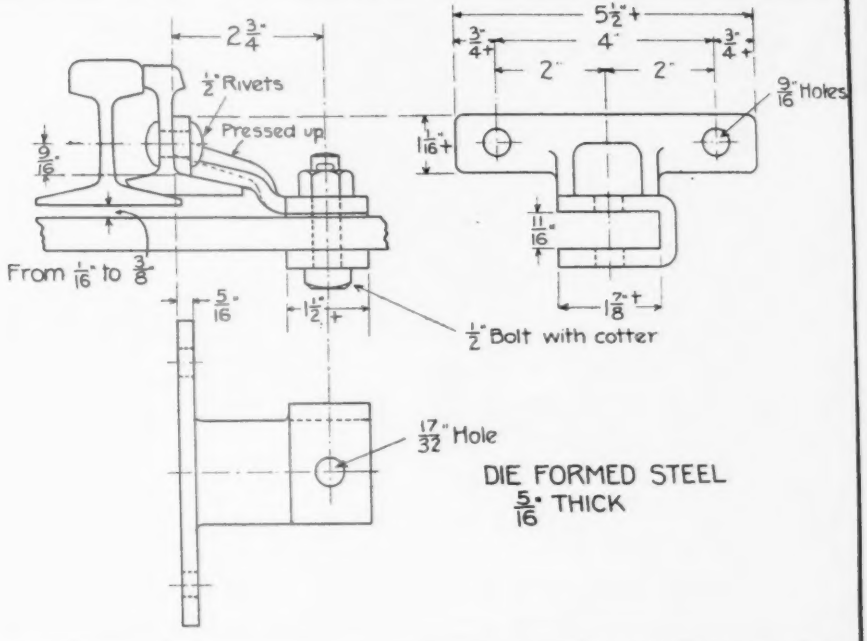
DRAWING 201-25

AMERICAN MINING CONGRESS
STANDARDIZATION DIVISION
MINE TRACKS & SIGNALS

SIDE JAW CLIP
FOR SWITCHES
16 TO 35 LB. RAILS

Drawn Dec.-1925 Submitted Dec.-1925 Approved
Revised Revised Revised

DRAWING No. 300-25



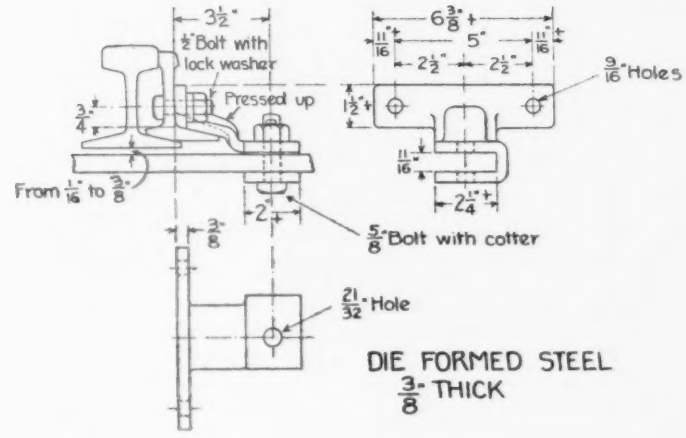
DRAWING No. 300-25

AMERICAN MINING CONGRESS
STANDARDIZATION DIVISION
MINE TRACKS & SIGNALS

SIDE JAW CLIP
FOR SWITCHES
40 TO 45 LB. RAILS

Drawn Dec.-1925 Submitted Dec.-1925 Approved
Revised Revised Revised

DRAWING No. 301-25



DRAWING No. 301-25

28. Accessories for switches shall be as shown on the following drawings:

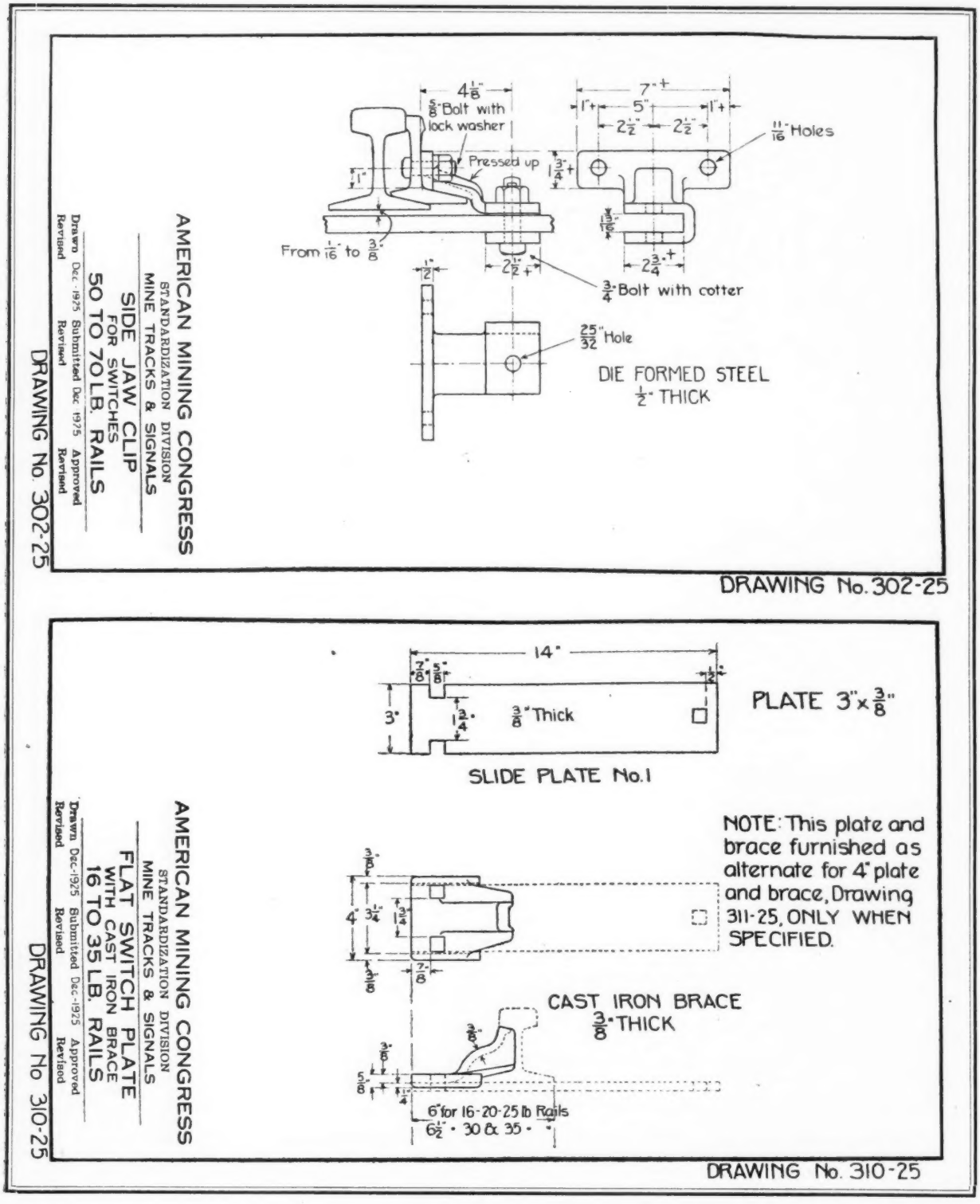
Article	Rail	Drawing
Side-jaw clip	16 to 35 lbs.	300-25
Side-jaw clip	40 & 45 lbs.	301-25
Side-jaw clip	50 to 75 lbs.	302-25
Flat switch plate (cast-iron brace)	16 to 35 lbs.	310-25
Flat switch plate (M. I. or forged brace)	16 to 35 lbs.	311-25
Riser switch plate	16 to 35 lbs.	312-25
Riser switch plate	40 to 70 lbs.	313-25
Switch-heel plates	16 to 35 lbs.	320-25
Switch-heel plates	40 to 70 lbs.	321-25

Recommendations for guard rails, turnouts and switch stands have not been considered up to this time, and will be submitted at a future date.

CONVEYORS WITH CONCENTRATED MINING

(*Continued from page* 281)

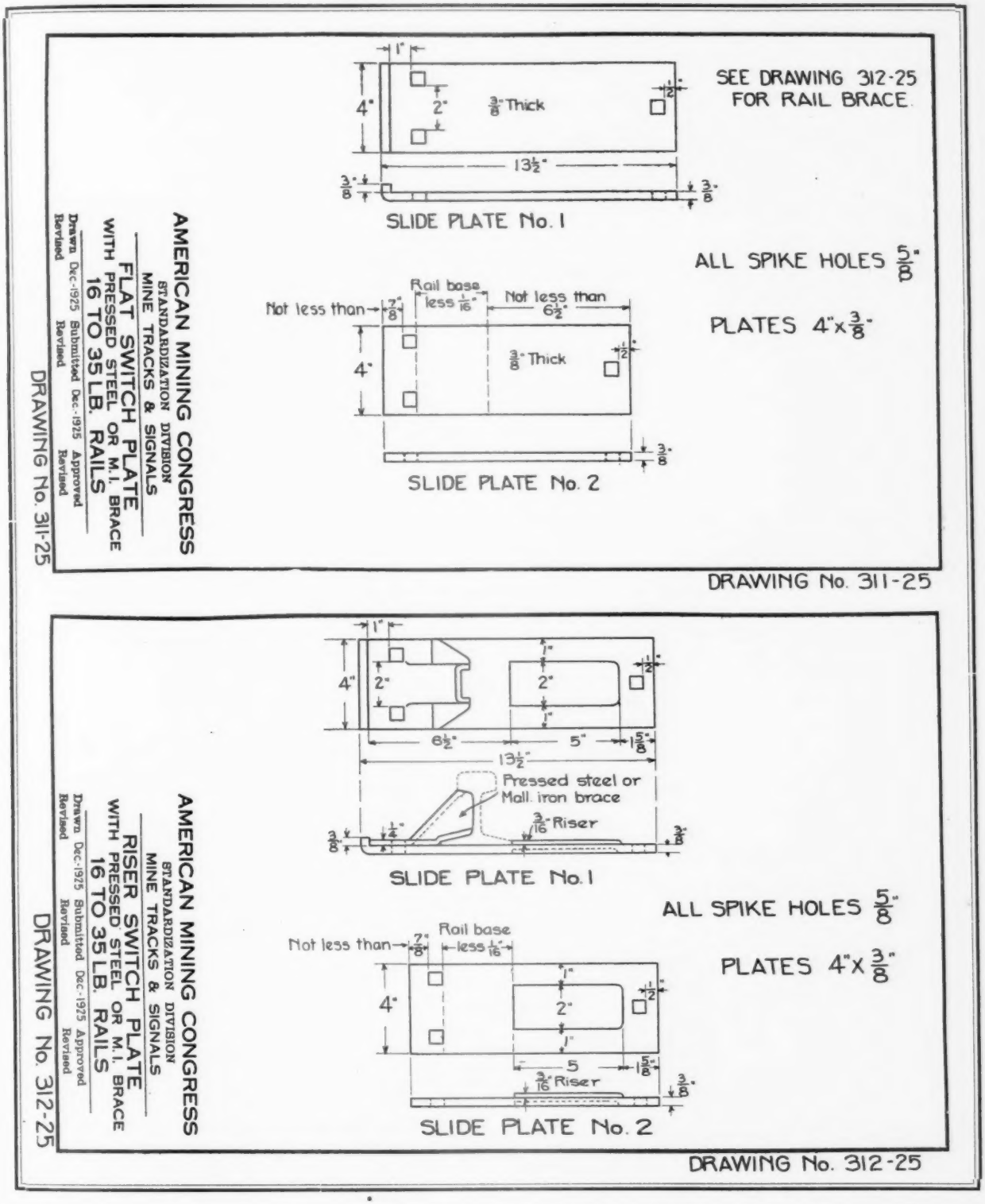
In this case with some double shifting of headings, enough territory was developed in the one mine, so that by using concentrated methods, the loaders from



the abandoned property could be given loading places. While it did not require conveyors to accomplish these results, a larger output and lower costs could have been effected by their adoption.

The following are some of the advantages to be derived from replacing cars and gathering motors on room and pillar work, by conveyors:

1. No track need be laid except on entries.
2. No room switches are needed.
3. No gathering motors.
4. Active working area open covers about one-third that of ordinary hand loading methods, on the basis of two clean-ups as outlined above.
5. Mining machines stay in working places and while it takes more of them for a given tonnage, they do not have to be equipped with trucks, and men do



not have to be paid for loading and unloading them and taking them from place to place.

6. In thin seams larger mine cars may be used as the car does not have to leave the entry.

7. Labor is concentrated giving better supervision with the same number of foremen.

8. As cars are delivered to central loading points by main line motors a complete trip at a time, there should be fewer delays from car delivery.

9. Coal is loaded into conveyors by hand with less physical exertion than into cars.

10. Ventilation is simpler as there is not as much territory open to be ventilated.

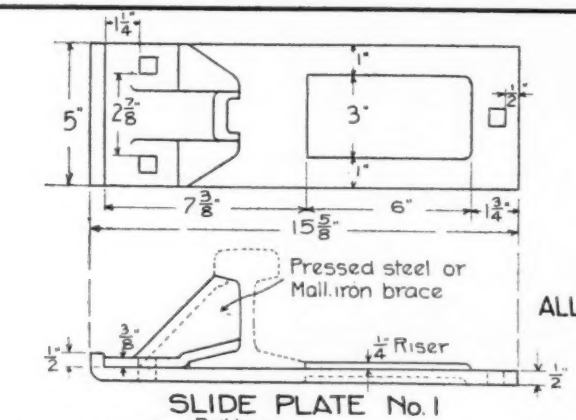
11. Better roof conditions may be expected as the coal extraction moves

AMERICAN MINING CONGRESS
STANDARDIZATION DIVISION
MINE TRACKS & SIGNALS

RISER SWITCH PLATE
WITH PRESSED STEEL OR M.I. BRACE
40 TO 70 LB. RAILS

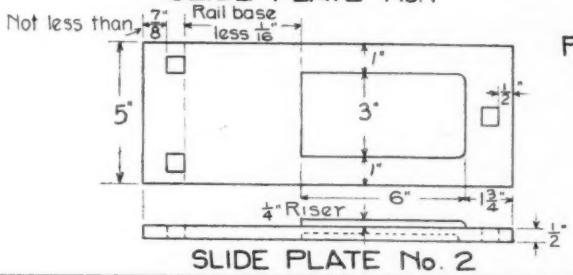
Drawn Dec·1925 Submitted Dec·1925 Approved
Revised Revised Revised

DRAWING No. 313-25



SLIDE PLATE No. 1

ALL SPIKE HOLES ⅝"



SLIDE PLATE No. 2

PLATES 5"x½"

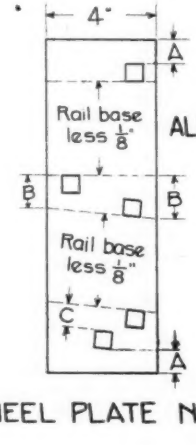
DRAWING No. 313-25

AMERICAN MINING CONGRESS
STANDARDIZATION DIVISION
MINE TRACKS & SIGNALS

SWITCH HEEL PLATES
16 TO 35 LB. RAILS

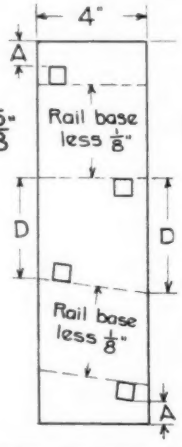
Drawn Dec·1925 Submitted Dec·1925 Approved
Revised Revised Revised

DRAWING No. 320-25



HEEL PLATE No. 3

ALL SPIKE HOLES ⅝"



HEEL PLATE No. 4

PLATES 4"x⅜"

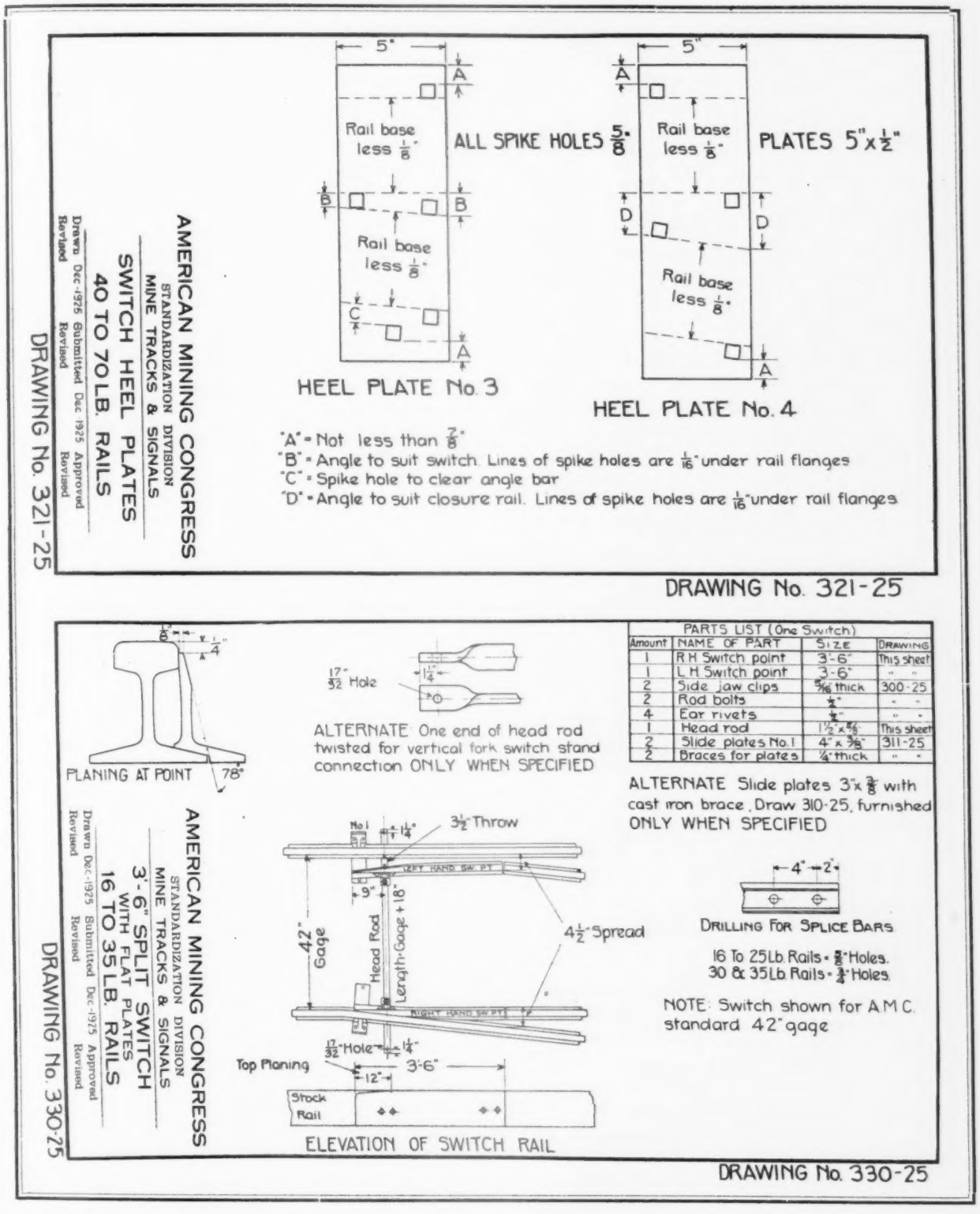
"A" = Not less than ⅞".
"B" = Angle to suit switch. Lines of spike holes are 1/16" under rail flanges.
"C" = Spike hole to clear angle bar.
"D" = Angle to suit closure rail. Lines of spike holes are 1/16" under rail flanges.

DRAWING No. 320-25

faster, and rooms do not stand open so long.

12. Less main line and entry track has to be maintained for a given production as more coal can be produced per entry.

The operator who is contemplating the use of face conveyors can get a better idea of the concentration he may expect, after he has given the conveyors a trial on a small scale, but over a period of time sufficient to enable him to estimate accurately the increase in tonnage per employe as compared with his present methods of mining. Such an experiment will determine many of the details necessary to be worked out in applying face conveyors to his particular local conditions.


AMERICAN MINING CONGRESS
STANDARDIZATION DIVISION
MINE TRACKS & SIGNALS
SWITCH HEEL PLATES
40 TO 70 LB. RAILS
Drawn Dec-1925 Submitted Dec 1925 Approved
Revised Revised Revised
DRAWING No. 321-25
5"
A
Rail base less 1/8"
ALL SPIKE HOLES 5/8"
PLATES 5"x1/2"
B
C
D
HEEL PLATE No. 3
HEEL PLATE No. 4
"A" = Not less than 7/8"
"B" = Angle to suit switch. Lines of spike holes are 1/16" under rail flanges
"C" = Spike hole to clear angle bar
"D" = Angle to suit closure rail. Lines of spike holes are 1/16" under rail flanges
DRAWING No. 321-25
PLANING AT POINT
78°
17/32" Hole
ALTERNATE One end of head rod twisted for vertical fork switch stand connection ONLY WHEN SPECIFIED
PARTS LIST (One Switch)
Amount | NAME OF PART | SIZE | DRAWING
1 | R.H. Switch point | 3'-6" | This sheet
1 | L.H. Switch point | 3'-6" | " "
2 | Side jaw clips | 5/16 thick | 300-25
2 | Rod bolts | 1/2" | " "
4 | Ear rivets | 1/2" | " "
1 | Head rod | 1 1/2" x 5/8" | This sheet
2 | Slide plates No. 1 | 4" x 3/8" | 311-25
2 | Braces for plates | 1/4" thick | " "
ALTERNATE Slide plates 3"x3/8" with cast iron brace. Draw 310-25, furnished ONLY WHEN SPECIFIED
AMERICAN MINING CONGRESS
STANDARDIZATION DIVISION
MINE TRACKS & SIGNALS
3'-6" SPLIT SWITCH
WITH FLAT PLATES
16 TO 35 LB. RAILS
Drawn Dec-1925 Submitted Dec-1925 Approved
Revised Revised Revised
DRAWING No. 330-25
No 1
3 1/2" Throw
LEFT HAND SW. PT.
9"
42" gage
Head Rod
Length = Gage + 18"
4 1/2" Spread
RIGHT HAND SW. PT.
17/32" Hole
Top Planing
12"
3'-6"
Stock Rail
ELEVATION OF SWITCH RAIL
4"
2"
DRILLING FOR SPLICE BARS
16 To 25 Lb. Rails = 3/8" Holes.
30 & 35 Lb. Rails = 1/2" Holes.
NOTE: Switch shown for A.M.C. standard 42" gage
DRAWING No. 330-25

INSTALLING AND MOVING ROOM CONVEYORS

(*Continued on page* 283)

place them alongside of the conveyor; also the tail end. See Fig. 4.

(4) Bring the car with the chain up in front of the conveyor.

(5) Lay the end of the chain over the end sprocket and pull it through on the top deck of driving end (Fig. 3).

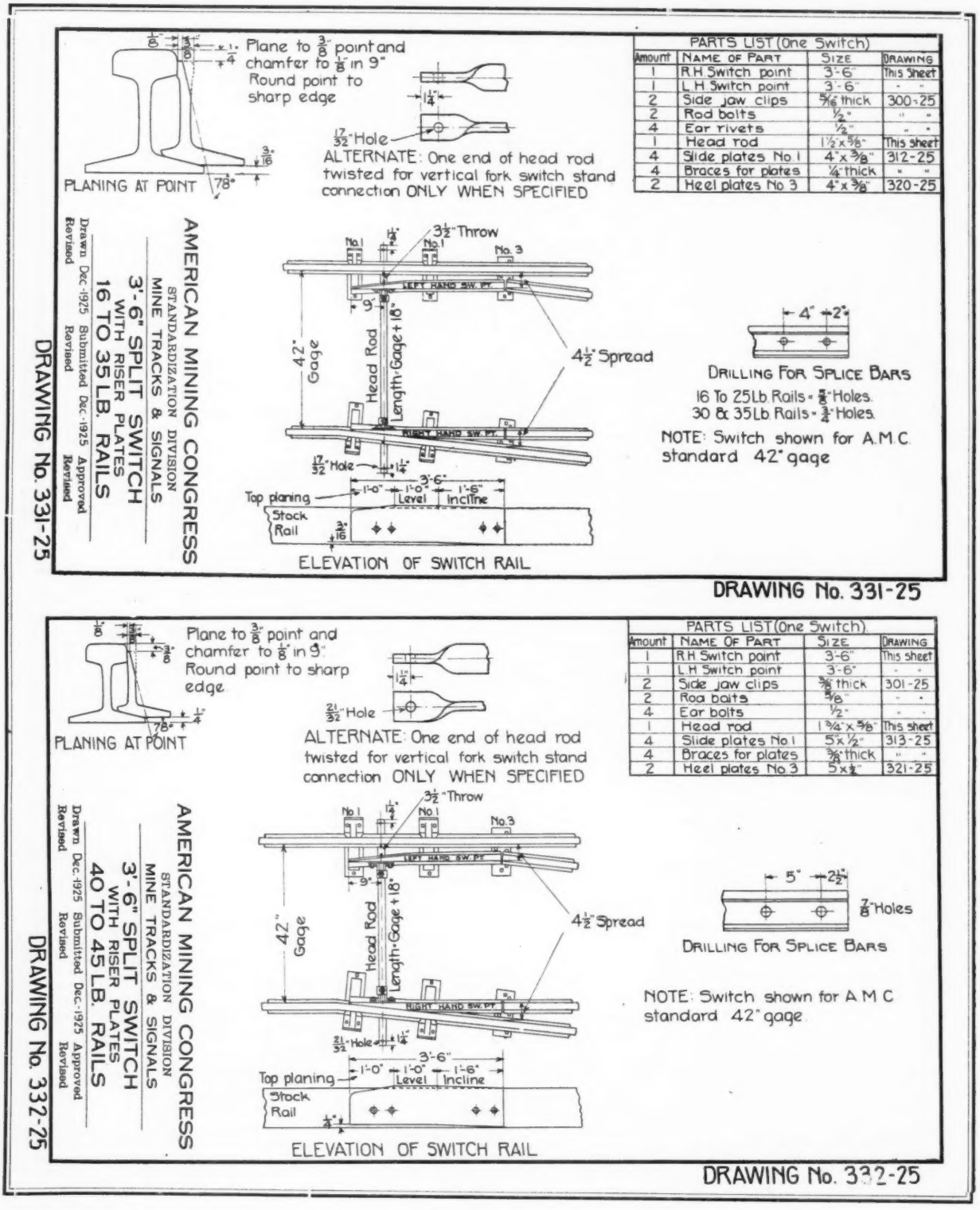
(6) Pull the chain down along the bottom pan until the entire length of conveyor is filled with chain. (Fig. 5).

(7) Thread a short piece of chain around the driving sprocket and couple up to chain in bottom of trough. (This piece of chain can be left in driving head when taken down).

(8) Put top troughs in position and couple up.

(9) Couple up tail end.

(10) Bring the car with chain up in front of the conveyor.


PARTS LIST (One Switch)
Amount | Name of Part | Size | Drawing
1 | R.H. Switch point | 3'-6" | This Sheet
1 | L.H. Switch point | 3'-6" | " "
2 | Side jaw clips | 5/16 thick | 300-25
2 | Rod bolts | 1/2" | " "
4 | Ear rivets | 1/2" | " "
1 | Head rod | 1 1/2 x 5/8" | This sheet
4 | Slide plates No 1 | 4" x 3/8" | 312-25
4 | Braces for plates | 1/4 thick | " "
2 | Heel plates No 3 | 4" x 3/8" | 320-25
Plane to 3/8" point and chamfer to 1/8" in 9" Round point to sharp edge
17/32" Hole
ALTERNATE: One end of head rod twisted for vertical fork switch stand connection ONLY WHEN SPECIFIED
PLANING AT POINT
78°
AMERICAN MINING CONGRESS
STANDARDIZATION DIVISION
MINE TRACKS & SIGNALS
3'-6" SPLIT SWITCH
WITH RISER PLATES
16 TO 35 LB. RAILS
Drawn Dec.-1925 Submitted Dec.-1925 Approved
Revised Revised Revised
DRAWING No. 331-25
3 1/2" Throw
No. 1
No. 3
LEFT HAND SW. PT.
RIGHT HAND SW. PT.
9"
42" Gage
Head Rod
Length-Gage+18"
4 1/2" Spread
17/32" Hole
Top planing
Stock Rail
3/16
1'-0" Level
1'-0"
1'-6" Incline
3'-6"
ELEVATION OF SWITCH RAIL
4" 2"
DRILLING FOR SPLICE BARS
16 To 25 Lb Rails - 5/8" Holes.
30 & 35 Lb Rails - 3/4" Holes.
NOTE: Switch shown for A.M.C. standard 42" gage
DRAWING No. 331-25

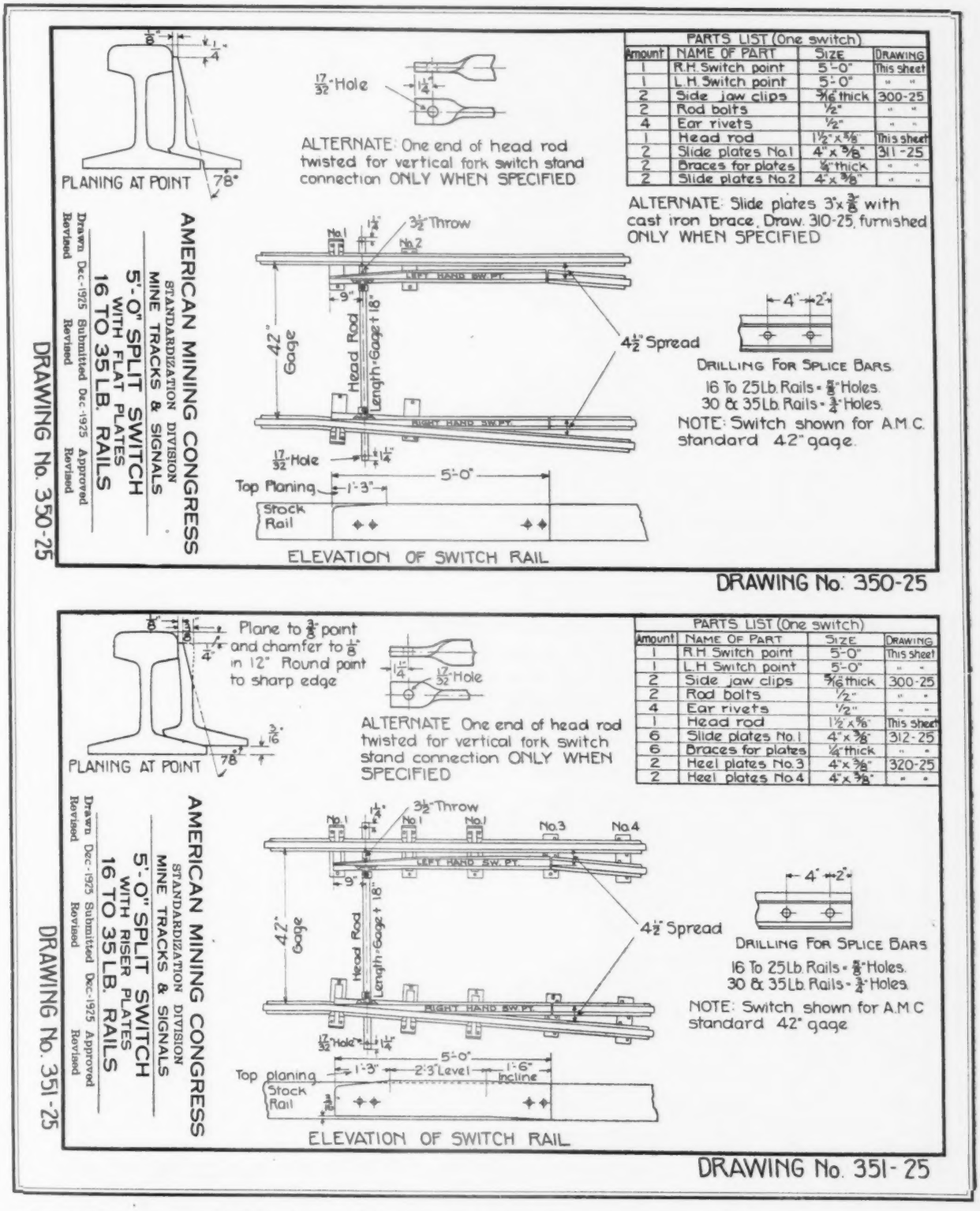
PARTS LIST (One Switch)
Amount | Name Of Part | Size | Drawing
1 | R.H. Switch point | 3'-6" | This sheet
1 | L.H. Switch point | 3'-6" | " "
2 | Side jaw clips | 5/8 thick | 301-25
2 | Rod bolts | 5/8" | " "
4 | Ear bolts | 1/2" | " "
1 | Head rod | 1 3/4" x 5/8" | This sheet
4 | Slide plates No 1 | 5" x 1/2" | 313-25
4 | Braces for plates | 3/8 thick | " "
2 | Heel plates No 3 | 5" x 1/2" | 321-25
Plane to 3/8" point and chamfer to 1/8" in 9" Round point to sharp edge
21/32" Hole
ALTERNATE: One end of head rod twisted for vertical fork switch stand connection ONLY WHEN SPECIFIED
PLANING AT POINT
78°
AMERICAN MINING CONGRESS
STANDARDIZATION DIVISION
MINE TRACKS & SIGNALS
3'-6" SPLIT SWITCH
WITH RISER PLATES
40 TO 45 LB. RAILS
Drawn Dec.-1925 Submitted Dec.-1925 Approved
Revised Revised Revised
DRAWING No. 332-25
3 1/2" Throw
No. 1
No. 3
LEFT HAND SW. PT.
RIGHT HAND SW. PT.
9"
42" Gage
Head Rod
Length-Gage+18"
4 1/2" Spread
21/32" Hole
Top planing
Stock Rail
1/4"
1'-0" Level
1'-0"
1'-6" Incline
3'-6"
ELEVATION OF SWITCH RAIL
5" 2 1/2"
7/8" Holes
DRILLING FOR SPLICE BARS
NOTE: Switch shown for A.M.C. standard 42" gage
DRAWING No. 332-25

(11) Thread the chain over the sprocket through upper deck of the driving end, and pull it down along the conveyor until all of the chain is in place.

(12) Couple up chain at the head end.

(13) Couple the chain at the tail end; the lower strand should, when in place, be long enough so that it at least reaches around the sprocket on the tail end. By using a bar in the wheel provided on the shaft at the tail end, the sprocket can be turned and the entire length of chain pulled so as to give slack for making the final coupling.

The driving end of the conveyor can, if so desired, be provided with a capstan, and a snatch block can be placed at the tail end of the conveyor and a manila rope used for pulling the chain on to the conveyor. In this case longer lengths of chain can be pulled into the conveyor at a time. The same manila rope can also be used for handling the truck that runs in the trough.

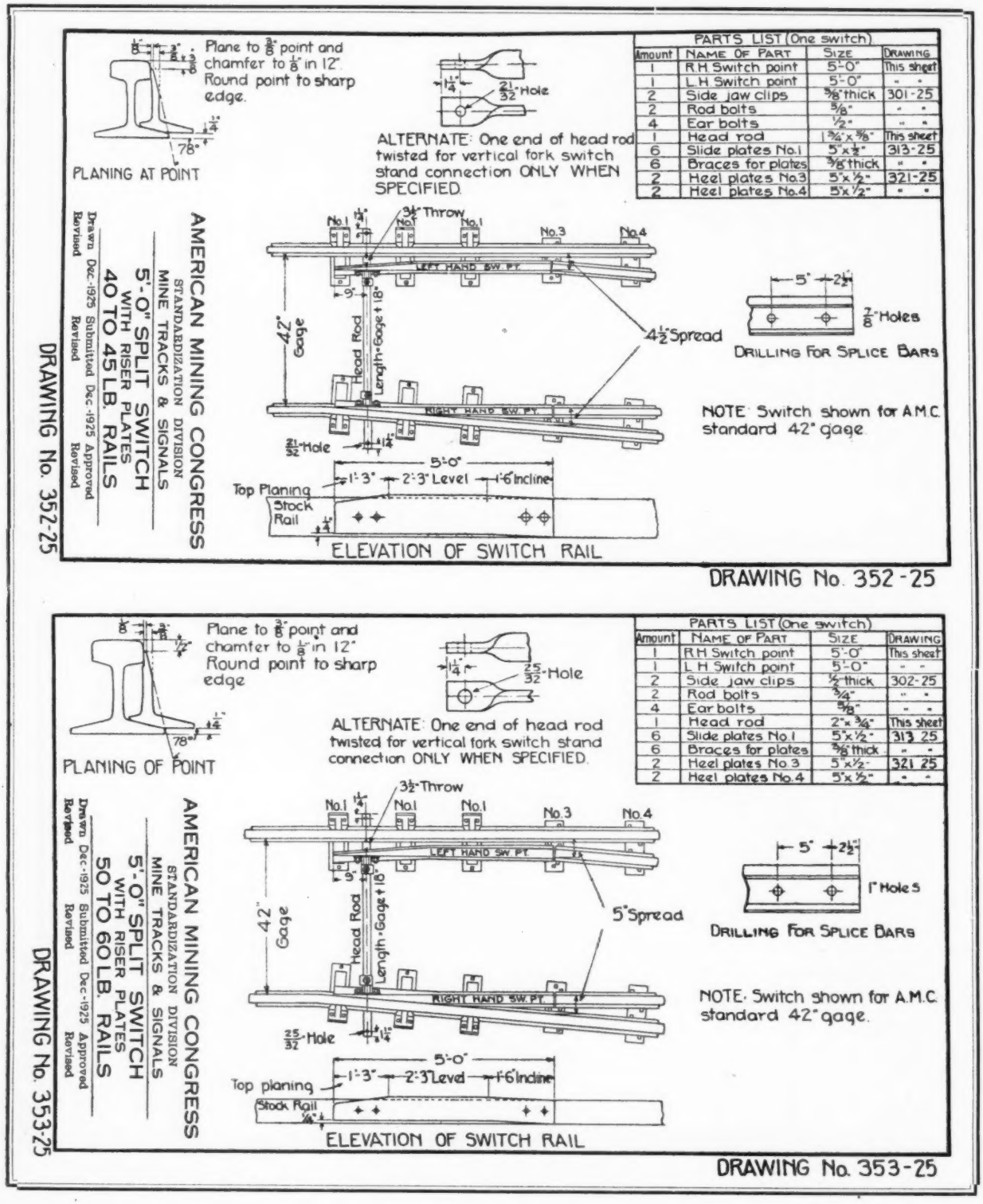

PARTS LIST (One switch)
Amount | NAME OF PART | SIZE | DRAWING
1 | R.H. Switch point | 5'-0" | This sheet
1 | L.H. Switch point | 5'-0" | " "
2 | Side jaw clips | 5/16" thick | 300-25
2 | Rod bolts | 1/2" | " "
4 | Ear rivets | 1/2" | " "
1 | Head rod | 1 1/2" x 5/8" | This sheet
2 | Slide plates No.1 | 4" x 5/8" | 311-25
2 | Braces for plates | 1/4" thick | " "
2 | Slide plates No.2 | 4" x 3/8" | " "
PLANING AT POINT
17/32" Hole
ALTERNATE: One end of head rod twisted for vertical fork switch stand connection ONLY WHEN SPECIFIED
ALTERNATE: Slide plates 3"x3/8" with cast iron brace, Draw. 310-25, furnished ONLY WHEN SPECIFIED
3 1/2" Throw
LEFT HAND SW. PT.
RIGHT HAND SW. PT.
42" Gage
Head Rod Length=Gage + 18"
4 1/2" Spread
DRILLING FOR SPLICE BARS
16 To 25 Lb. Rails = 5/8" Holes.
30 & 35 Lb. Rails = 3/4" Holes.
NOTE: Switch shown for A.M.C. standard 4'2" gage.
Top Planing
Stock Rail
5'-0"
ELEVATION OF SWITCH RAIL
AMERICAN MINING CONGRESS
STANDARDIZATION DIVISION
MINE TRACKS & SIGNALS
5'-0" SPLIT SWITCH
WITH FLAT PLATES
16 TO 35 LB. RAILS
Drawn Dec-1925 Submitted Dec-1925 Approved
Revised Revised Revised
DRAWING No. 350-25
DRAWING No. 350-25
PARTS LIST (One switch)
Amount | NAME OF PART | SIZE | DRAWING
1 | R.H. Switch point | 5'-0" | This sheet
1 | L.H. Switch point | 5'-0" | " "
2 | Side jaw clips | 5/16" thick | 300-25
2 | Rod bolts | 1/2" | " "
4 | Ear rivets | 1/2" | " "
1 | Head rod | 1 1/2" x 5/8" | This sheet
6 | Slide plates No.1 | 4" x 5/8" | 312-25
6 | Braces for plates | 1/4" thick | " "
2 | Heel plates No.3 | 4" x 5/8" | 320-25
2 | Heel plates No.4 | 4" x 5/8" | " "
Plane to 3/4" point and chamfer to 1/8" in 12" Round point to sharp edge
PLANING AT POINT
17/32" Hole
ALTERNATE One end of head rod twisted for vertical fork switch stand connection ONLY WHEN SPECIFIED
3 1/2" Throw
No.1 No.1 No.1 No.3 No.4
LEFT HAND SW. PT.
RIGHT HAND SW. PT.
42" Gage
Head Rod Length=Gage + 18"
4 1/2" Spread
DRILLING FOR SPLICE BARS
16 To 25 Lb. Rails = 5/8" Holes.
30 & 35 Lb. Rails = 3/4" Holes.
NOTE: Switch shown for A.M.C. standard 4'2" gage
Top planing
Stock Rail
1'-3"
2'-3" Level
1'-6" Incline
5'-0"
ELEVATION OF SWITCH RAIL
AMERICAN MINING CONGRESS
STANDARDIZATION DIVISION
MINE TRACKS & SIGNALS
5'-0" SPLIT SWITCH
WITH RISER PLATES
16 TO 35 LB. RAILS
Drawn Dec-1925 Submitted Dec-1925 Approved
Revised Revised Revised
DRAWING No. 351-25
DRAWING No. 351-25

SAMPLING AND EXAMINING MINE GASES

Methods employed in the sampling and examination of mine gases and natural gas are described in Bulletin 197, just issued by the Bureau of Mines.

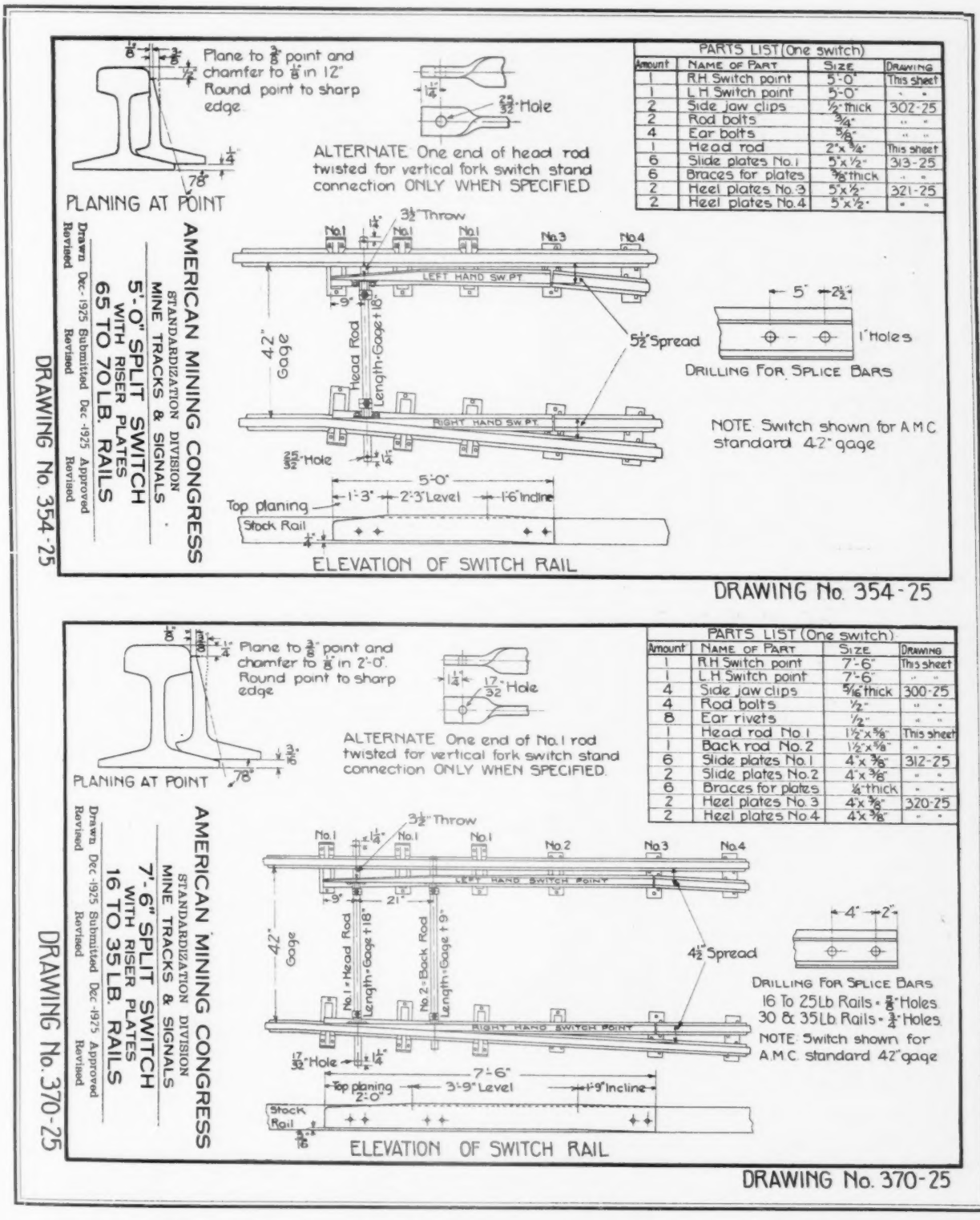
The bureau, as part of its designated duty of investigating the causes of mine accidents, is conducting at its experiment station in Pittsburgh, Pa., a study of mine gases. Some of the work already done in connection with this study is outlined below.

A large number of samples of mine gas have been collected under normal conditions in returns and in splits, and at other points in the ventilating current; also at the face, in the goave or gob, in unventilated places, and wherever the air was still. Samples have also


PARTS LIST (One switch)
Amount | Name of Part | Size | Drawing
1 | R.H. Switch point | 5'-0" | This sheet
1 | L.H. Switch point | 5'-0" | " "
2 | Side jaw clips | 3/8" thick | 301-25
2 | Rod bolts | 5/8" | " "
4 | Ear bolts | 1/2" | " "
1 | Head rod | 1 3/4" x 5/8" | This sheet
6 | Slide plates No.1 | 5" x 1/2" | 313-25
6 | Braces for plates | 3/8" thick | " "
2 | Heel plates No.3 | 5" x 1/2" | 321-25
2 | Heel plates No.4 | 5" x 1/2" | " "
Plane to 3/8" point and chamfer to 1/8" in 12". Round point to sharp edge.
PLANING AT POINT
ALTERNATE: One end of head rod twisted for vertical fork switch stand connection ONLY WHEN SPECIFIED.
21/32" Hole
3 1/2" Throw
No.1 No.1 No.1 No.3 No.4
LEFT HAND SW. PT.
RIGHT HAND SW. PT.
Head Rod Length = Gage + 18"
42" Gage
4 1/2" Spread
21/32" Hole
5'-0"
1'-3" 2'-3" Level 1'-6" Incline
Top Planing
Stock Rail
ELEVATION OF SWITCH RAIL
5" 2 1/2"
7/8" Holes
DRILLING FOR SPLICE BARS
NOTE: Switch shown for A.M.C. standard 42" gage.
AMERICAN MINING CONGRESS
STANDARDIZATION DIVISION
MINE TRACKS & SIGNALS
5'-0" SPLIT SWITCH
WITH RISER PLATES
40 TO 45 LB. RAILS
Drawn Dec.-1925 Submitted Dec.-1925 Approved
Revised Revised Revised
DRAWING No. 352-25
DRAWING No. 352-25
PARTS LIST (One switch)
Amount | Name of Part | Size | Drawing
1 | R.H. Switch point | 5'-0" | This sheet
1 | L.H. Switch point | 5'-0" | " "
2 | Side jaw clips | 1/2" thick | 302-25
2 | Rod bolts | 3/4" | " "
4 | Ear bolts | 5/8" | " "
1 | Head rod | 2" x 3/4" | This sheet
6 | Slide plates No.1 | 5" x 1/2" | 313-25
6 | Braces for plates | 3/8" thick | " "
2 | Heel plates No.3 | 5" x 1/2" | 321-25
2 | Heel plates No.4 | 5" x 1/2" | " "
Plane to 3/8" point and chamfer to 1/8" in 12". Round point to sharp edge
PLANING OF POINT
ALTERNATE: One end of head rod twisted for vertical fork switch stand connection ONLY WHEN SPECIFIED.
25/32" Hole
3 1/2" Throw
No.1 No.1 No.1 No.3 No.4
LEFT HAND SW. PT.
RIGHT HAND SW. PT.
Head Rod Length = Gage + 18"
42" Gage
5" Spread
25/32" Hole
5'-0"
1'-3" 2'-3" Level 1'-6" Incline
Top planing
Stock Rail
ELEVATION OF SWITCH RAIL
5" 2 1/2"
1" Holes
DRILLING FOR SPLICE BARS
NOTE: Switch shown for A.M.C. standard 42" gage.
AMERICAN MINING CONGRESS
STANDARDIZATION DIVISION
MINE TRACKS & SIGNALS
5'-0" SPLIT SWITCH
WITH RISER PLATES
50 TO 60 LB. RAILS
Drawn Dec.-1925 Submitted Dec.-1925 Approved
Revised Revised Revised
DRAWING No. 353-25
DRAWING No. 353-25

been obtained under abnormal conditions, as after explosions and while mine fires were in progress, or from sealed areas behind stoppings and dams where the air had been stagnant for some time. Chemical changes in the composition of mine atmospheres during mine fires have been studied, and conditions peculiar to certain mines have been investigated.

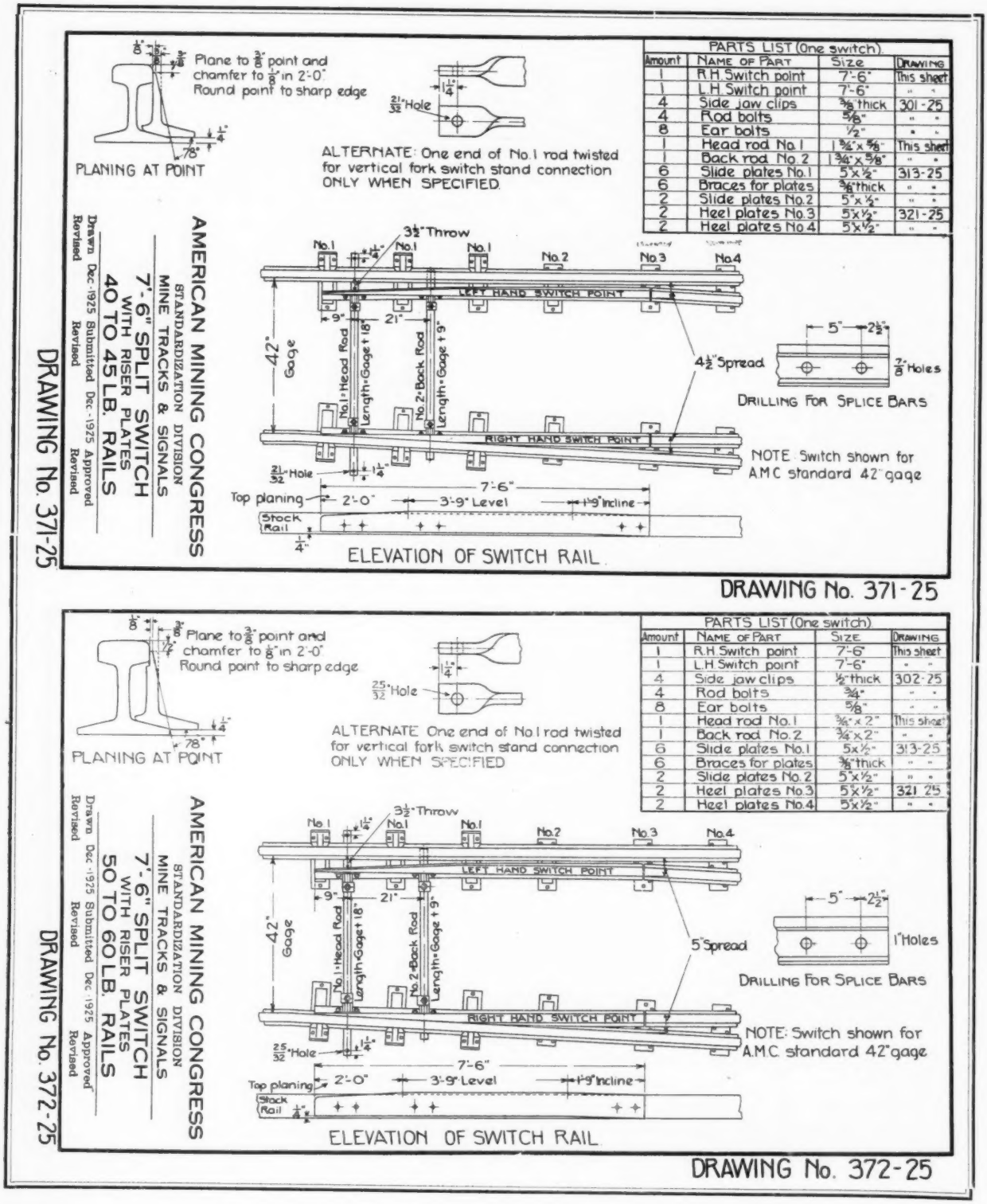
The effect of a change in atmospheric pressure on the escape of gas in coal mines has been studied. Explosives have been fired in both coal and metal mines, and samples of resulting gases have been collected to ascertain the degree to which these vitiate the air. A series of samples in mines where gasoline locomotives were being used has been examined in order to ascertain the degree to which the exhaust gases from such locomotives foul the air. Experiments


PARTS LIST (One switch)
Amount | Name of Part | Size | Drawing
1 | R.H. Switch point | 5'-0" | This sheet
1 | L.H. Switch point | 5'-0" | " "
2 | Side jaw clips | ½" thick | 302-25
2 | Rod bolts | ¾" | " "
4 | Ear bolts | ⅝" | " "
1 | Head rod | 2" x ¾" | This sheet
6 | Slide plates No.1 | 5" x ½" | 313-25
6 | Braces for plates | ⅜" thick | " "
2 | Heel plates No.3 | 5" x ½" | 321-25
2 | Heel plates No.4 | 5" x ½" | " "
Plane to ⅜" point and chamfer to ⅛" in 12" Round point to sharp edge
PLANING AT POINT
ALTERNATE One end of head rod twisted for vertical fork switch stand connection ONLY WHEN SPECIFIED
25/32" Hole
3½" Throw
LEFT HAND SW PT
RIGHT HAND SW PT
Head Rod Length = Gage + 18"
42" Gage
5½" Spread
5" 2½" 1" Holes
DRILLING FOR SPLICE BARS
NOTE Switch shown for A.M.C. standard 4.2" gage
5'-0"
1'-3" 2'-3" Level 1'-6" Incline
Top planing
Stock Rail
ELEVATION OF SWITCH RAIL
AMERICAN MINING CONGRESS
STANDARDIZATION DIVISION
MINE TRACKS & SIGNALS
5'-0" SPLIT SWITCH
WITH RISER PLATES
65 TO 70 LB. RAILS
Drawn Dec-1925 Submitted Dec-1925 Approved
Revised Revised Revised
DRAWING No. 354-25
DRAWING No. 354-25
PARTS LIST (One switch)
Amount | Name of Part | Size | Drawing
1 | R.H. Switch point | 7'-6" | This sheet
1 | L.H. Switch point | 7'-6" | " "
4 | Side jaw clips | 5/16" thick | 300-25
4 | Rod bolts | ½" | " "
8 | Ear rivets | ½" | " "
1 | Head rod No.1 | 1½" x 5/8" | This sheet
1 | Back rod No.2 | 1½" x 5/8" | " "
6 | Slide plates No.1 | 4" x 3/8" | 312-25
2 | Slide plates No.2 | 4" x 3/8" | " "
6 | Braces for plates | ¼" thick | " "
2 | Heel plates No.3 | 4" x 3/8" | 320-25
2 | Heel plates No.4 | 4" x 3/8" | " "
Plane to ⅜" point and chamfer to ⅛" in 2'-0" Round point to sharp edge
PLANING AT POINT
ALTERNATE One end of No.1 rod twisted for vertical fork switch stand connection ONLY WHEN SPECIFIED.
17/32" Hole
3½" Throw
LEFT HAND SWITCH POINT
RIGHT HAND SWITCH POINT
No.1 Head Rod Length = Gage + 18"
No.2 Back Rod Length = Gage + 9"
42" Gage
4½" Spread
4" 2"
DRILLING FOR SPLICE BARS
16 To 25 Lb Rails - ⅝" Holes
30 & 35 Lb Rails - ¾" Holes
NOTE Switch shown for A.M.C. standard 42" gage
7'-6"
Top planing 2'-0" 3'-9" Level 1'-9" Incline
Stock Rail
ELEVATION OF SWITCH RAIL
AMERICAN MINING CONGRESS
STANDARDIZATION DIVISION
MINE TRACKS & SIGNALS
7'-6" SPLIT SWITCH
WITH RISER PLATES
16 TO 35 LB. RAILS
Drawn Dec-1925 Submitted Dec-1925 Approved
Revised Revised Revised
DRAWING No. 370-25
DRAWING No. 370-25

have also been made in regard to the relative effect of carbon monoxide upon men and small animals, the effect of oxygen deficiency on men and animals, and the flammable limits of combustible gases found normally in mines and during and after mine fires.

These investigations have necessitated making numerous gas analyses, many requiring special methods and designs of apparatus. The methods described in Bulletin 197 are largely an outgrowth of the above investigations and are now used as standard methods at the gas laboratory of the Pittsburgh station of the Bureau of Mines.

The bulletin contains detailed instructions in regard to the collection of samples of mine gases by the vacuum method, by air displacement, and by water displacement. Instructions in regard to

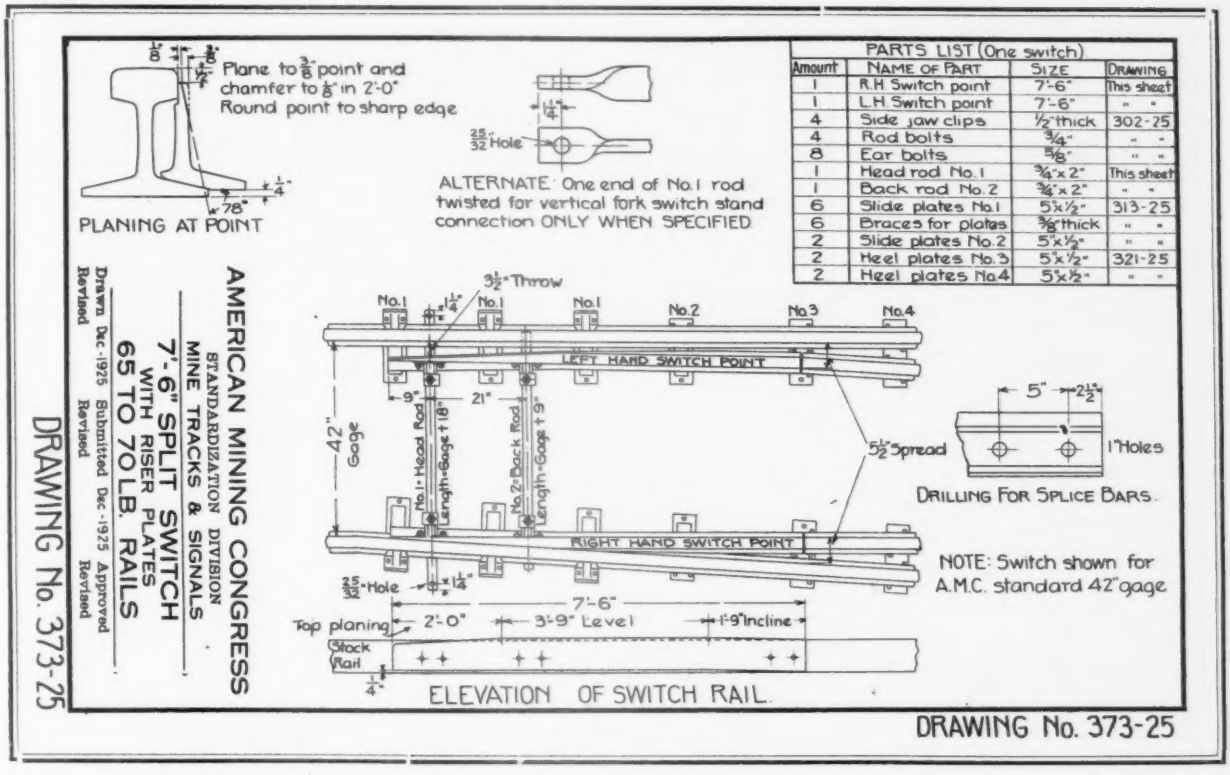

PARTS LIST (One switch)
Amount | Name of Part | Size | Drawing
1 | R.H. Switch point | 7'-6" | This sheet
1 | L.H. Switch point | 7'-6" | " "
4 | Side jaw clips | ⅜ thick | 301-25
4 | Rod bolts | ⅝" | " "
8 | Ear bolts | ½" | " "
1 | Head rod No. 1 | 1¾" x ⅝" | This sheet
1 | Back rod No. 2 | 1¾" x ⅝" | " "
6 | Slide plates No. 1 | 5" x ½" | 313-25
6 | Braces for plates | ⅜" thick | " "
2 | Slide plates No. 2 | 5" x ½" | " "
2 | Heel plates No. 3 | 5" x ½" | 321-25
2 | Heel plates No. 4 | 5" x ½" | " "
Plane to 3/8" point and chamfer to 1/8" in 2'-0" Round point to sharp edge
PLANING AT POINT
ALTERNATE: One end of No. 1 rod twisted for vertical fork switch stand connection ONLY WHEN SPECIFIED
21/32" Hole
3½" Throw
No. 1
No. 2
No. 3
No. 4
LEFT HAND SWITCH POINT
RIGHT HAND SWITCH POINT
42" Gage
No. 1 Head Rod Length = Gage + 18"
No. 2 Back Rod Length = Gage + 9"
4½" Spread
5" 2½"
⅞" Holes
DRILLING FOR SPLICE BARS
NOTE: Switch shown for A.M.C. standard 42" gage
Top planing 2'-0" 3'-9" Level 1'-9" Incline
7'-6"
Stock Rail
ELEVATION OF SWITCH RAIL
AMERICAN MINING CONGRESS
STANDARDIZATION DIVISION
MINE TRACKS & SIGNALS
7'-6" SPLIT SWITCH
WITH RISER PLATES
40 TO 45 LB. RAILS
Drawn Dec. 1925 Submitted Dec. 1925 Approved
Revised Revised Revised
DRAWING No. 371-25
DRAWING No. 371-25

PARTS LIST (One switch)
Amount | Name of Part | Size | Drawing
1 | R.H. Switch point | 7'-6" | This sheet
1 | L.H. Switch point | 7'-6" | " "
4 | Side jaw clips | ½" thick | 302-25
4 | Rod bolts | ¾" | " "
8 | Ear bolts | ⅝" | " "
1 | Head rod No. 1 | ⅜" x 2" | This sheet
1 | Back rod No. 2 | ¾" x 2" | " "
6 | Slide plates No. 1 | 5" x ½" | 313-25
6 | Braces for plates | ⅜" thick | " "
2 | Slide plates No. 2 | 5" x ½" | " "
2 | Heel plates No. 3 | 5" x ½" | 321-25
2 | Heel plates No. 4 | 5" x ½" | " "
Plane to 3/8" point and chamfer to 1/8" in 2'-0" Round point to sharp edge
PLANING AT POINT
ALTERNATE: One end of No. 1 rod twisted for vertical fork switch stand connection ONLY WHEN SPECIFIED
25/32" Hole
3½" Throw
No. 1
No. 2
No. 3
No. 4
LEFT HAND SWITCH POINT
RIGHT HAND SWITCH POINT
42" Gage
No. 1 Head Rod Length = Gage + 18"
No. 2 Back Rod Length = Gage + 9"
5" Spread
5" 2½"
1" Holes
DRILLING FOR SPLICE BARS
NOTE: Switch shown for A.M.C. standard 42" gage
Top planing 2'-0" 3'-9" Level 1'-9" Incline
7'-6"
Stock Rail
ELEVATION OF SWITCH RAIL
AMERICAN MINING CONGRESS
STANDARDIZATION DIVISION
MINE TRACKS & SIGNALS
7'-6" SPLIT SWITCH
WITH RISER PLATES
50 TO 60 LB. RAILS
Drawn Dec. 1925 Submitted Dec. 1925 Approved
Revised Revised Revised
DRAWING No. 372-25
DRAWING No. 372-25

determination of moisture are given. Methods for analysis of mine atmospheres by the use of modified Haldane apparatus are outlined. The workings of types of portable apparatus for the determination of carbon dioxide and methane and for the complete analysis of mine air are described. The determination of carbon monoxide by the pyrotannic acid method is described. Methods for the determination of oxides of nitrogen are given.

Apparatus for analyzing natural gas is described in the bulletin. Methods of determining heating value, the gasoline content and the density of natural gas are described.

Copies of Bulletin 197, "Sampling and Examination of Mine Gases and Natural Gas," may be obtained from the Bureau of Mines, Department of Commerce, Washington, D. C.


Plane to 3/8" point and chamfer to 1/8" in 2'-0"
Round point to sharp edge
PLANING AT POINT
ALTERNATE: One end of No.1 rod twisted for vertical fork switch stand connection ONLY WHEN SPECIFIED
PARTS LIST (One switch)
Amount | Name of Part | Size | Drawing
1 | R.H Switch point | 7'-6" | This sheet
1 | L.H Switch point | 7'-6" | " "
4 | Side jaw clips | 1/2" thick | 302-25
4 | Rod bolts | 3/4" | " "
8 | Ear bolts | 5/8" | " "
1 | Head rod No.1 | 3/4" x 2" | This sheet
1 | Back rod No.2 | 3/4" x 2" | " "
6 | Slide plates No.1 | 5" x 1/2" | 313-25
6 | Braces for plates | 3/8" thick | " "
2 | Slide plates No.2 | 5" x 1/2" | " "
2 | Heel plates No.3 | 5" x 1/2" | 321-25
2 | Heel plates No.4 | 5" x 1/2" | " "
3 1/2" Throw
No.1
No.2
No.3
No.4
LEFT HAND SWITCH POINT
RIGHT HAND SWITCH POINT
42" Gage
No.1 Head Rod Length=Gage+18"
No.2 Back Rod Length=Gage+9"
5 1/2" Spread
5"
2 1/2"
1" Holes
DRILLING FOR SPLICE BARS.
NOTE: Switch shown for A.M.C. standard 42" gage
25/32" Hole
7'-6"
Top planing
2'-0"
3'-9" Level
1'-9" Incline
Stock Rail
ELEVATION OF SWITCH RAIL.
AMERICAN MINING CONGRESS
STANDARDIZATION DIVISION
MINE TRACKS & SIGNALS
7'-6" SPLIT SWITCH
WITH RISER PLATES
65 TO 70 LB. RAILS
Drawn Dec-1925 Submitted Dec-1925 Approved
Revised Revised Revised
DRAWING No. 373-25
DRAWING No. 373-25

MINE HEROES

HEROES of peaceful industry whose resourcefulness and courage in time of danger served to brighten the annals of American mining have just been recognized in the awarding of the medals and diplomas of the Joseph A. Holmes Safety Association to Lee Fetty and John McNeil, of Farmington, W. Va., and R. D. Taylor, of Attala, Alabama.

Fetty, a machine boss, and McNeil, a compressor man, in the Jamison No. 8 mine of the Jamison Coal & Coke Co., Farmington, W. Va., were on duty underground when an explosion occurred on the night of January 14, 1926, resulting in the loss of the lives of 19 persons. At the first sign of danger, Fetty and McNeil arranged a plan for rounding up 22 men working in their section of the mine and collecting them at the compressor room. Finding that the air compressor room was too small in which to protect the men by erection of barricades against the deadly mine gases, the men were conducted to an entry, where quickly-constructed barricades preserved the lives of 20 of them until the crisis was past. Two of the men, who left the barricade in an effort to escape from the mine, lost their lives. It is considered that the lives of these 20 men were saved because of the judgment and courage displayed by Fetty and McNeil.

Taylor displayed rare heroism on December 19, 1925, in an attempt to save the life of Oscar Harris, a fellow workman at the Attala mine of the Sloss-Sheffield Steel and Iro.. Co., Attala, Ala. Harris had gone into a pump room to open an electric switch, while preparations were being made by Taylor to fire a round of 10 holes charged with gelatin dynamite, in a nearby slope of the mine. After lighting the fuses, Taylor started to leave the slope, but, discovering that Harris had fallen into live electric wires rushed back to the bottom of the slope hoping to cut off the sputtering fuses. He succeeded in cutting off some of the fuses, but was too late to complete the work before the discharge of the shots. Immediately following the discharge, Taylor, who had fortunately escaped injury from the blast, returned with another employe to Harris, moved his body from contact with the electric wires and endeavored unsuccessfully to resuscitate him. Although unable to save the life of his fellow employe, Taylor jeopardized his own life in the effort.

The medals and diplomas of the Joseph A. Holmes Safety Association are each year bestowed on those miners whose acts of courage and self-sacrifice in the succor of their comrades at perilous times are considered to be the most deserving of this high honor. The Joseph A. Holmes Safety Association, with its 148 affiliated chapters, is an organization numbering in its membership thousands of miners banded together for the promotion of safety in mining, and constitutes a living memorial to the memory of the first Director of the Bureau of Mines, generally regarded as the father of the mine-safety movement.

The honors for Fetty, McNeil and Taylor were recommended by representatives of the Bureau of Mines; the American Mining Congress; the National Coal Association; the United Mine Workers of America; the American Institute of Mining and Metallurgical Engineers; the American Federation of Labor; the American Society of Mechanical Engineers; the American Society for Testing Materials; the Mining and Metallurgical Society of America; the American National Red Cross; the American Chemical Society; the Mine Inspectors' Institute of America; the Geological Society of America; and the International Railway Fuel Association, as members of the council of the Joseph A. Holmes Safety Association. Presentation of the medals is made at the international first-aid mine rescue contests which are held annually at different cities.

The Tariff Commission will grant a hearing here April 20 to interested parties as to the application of the flexible tariff provision to pig iron. The hearing will cover the difference in cost of production in this country and abroad.

PROPOSED COAL MINE DRAINAGE STANDARDS

PUMPS FOR DEVELOPMENT WORK

A.—Pumps for development work are needed during the opening of a new mine or for the extension of entries or headings, etc., in an operating mine.

B. Location.—Pumps are needed to remove water from rooms, headings, slopes, shafts, etc., where an accumulation would interfere with the successful development of the mine and removal of coal. These pumps should be located in a temporary place as near as possible to the water accumulation, but away from the haulage roads and working places, so as to not interfere with the mining operation. Wherever possible, pumps should be so placed in relation to the body of water to be pumped that a shutdown for a reasonable period of time will not place the apparatus in danger of being drowned out nor handicap the workmen making repairs.

C. Construction of Station.—Pump installations for development work are of a temporary character and installations should be made accordingly. The pumps should be so located as to be easily accessible for repairs and oiling, etc., and so located that the attendant can move about the pump freely without coming in contact with any moving parts. Pumps should be so located that the main current of air does not pass over and around them, and in all cases the pumps should be on the intake air current and not on the return air current.

D. Sumps.—Large sump capacity is not generally practical during development work, as considerable of the water is gathered in small quantities from numerous working places.

E. Motor and Control.—Motor and control should be installed in accordance with recommendations and standards submitted by the Power Equipment Section of the Standardization Committee.

F. Type and Capacity of Pumps.—Piston and plunger pumps are generally employed for development work. These pumps should be mounted on trucks or skids for ease of handling. Pumps should have a capacity of from 20 to 100 gallons per minute, at 125 feet total dynamic head.

Where quantities in excess of 100 gallons per minute are to be handled, rotary and centrifugal pumps are used to some extent, and if the volume of water is fairly constant these pumps prove very satisfactory.

G. General Specifications.—A pump for developing work should start without priming, pump air and water alternately, and keep a flow of water with intake and of suction pipe only partially submerged.

Pumps should be so constructed that valves are readily accessible for cleaning, and that small chunks of coal and other solid matter, such as are constantly being worked into the sumps, or pools of water, will go through without clogging. The proper use of strainers on suction lines will largely eliminate this difficulty.

Pumps should be so constructed to be lubricated without excessive waste of oil. They should be fully equipped with oil or grease cups, whichever are best suitable for the bearings. For centrifugal pumps the bearings should be so constructed that acid water leaking from the packing glands can not get into any of the bearing surfaces. In the case of plunger pumps, the plunger should be constructed of material that will resist the corrosive action of acid in the water; and that will also resist scoring and excessive wear of the packing. In piston pumps the working barrel or liner should be constructed of material that will resist the corrosive action of the acid water and the wear of the piston packing.

H. Discharge and Suction Pipe.—The discharge pipe should be of sufficient size that the total dynamic does not work the pump above its rated capacity. Where the water handled contains a large amount of corrosive acid it is advisable to use wood, or wood lined, or other acid-resisting pipe.

Care should be taken to keep the pipe blocked off the bottom of the heading, or chamber, so that water can not come in contact with the outside of the pipe.

Strainers should be used on intake end of suction pipes. Loss of head due to friction should be taken from the Standards of the Hydraulic Society's report of 1925, which will be found at end of report on Permanent Pumping Stations.

The suction lines should be as direct and short as possible. They should, if possible, be at least one or two sizes larger than the pump nozzle. Pipe should be laid out so that air pockets are eliminated. Pipe should be tested with pressure for leaks.

I. General Recommendations for the Manufacture and Selection of Pumps.—Wherever possible United States standard thread be used on all bolts, nuts, and plugs.

As few different sizes of bolts, capscrews, studs, etc., be used in the construction of a mine pump as are compatible with good design.

As complete a standardization of pumping equipment by individual users as conditions will permit and when a purchaser is on the market for additional equipment, the keeping in mind of the fact that all other things being equal, a saving in initial cost, unless very considerable in amount, rarely compensates for having to keep two different sets of repair parts in stock.

PERMANENT PUMPING STATIONS

A. Location. — A complete drainage survey should be made of all mines before the location of any permanent pumping stations. This should consist of a topographical survey of the mine workings, giving the elevation of all entries used for haulage, ventilation, and drainage. In addition a survey should be made showing the amount of water encountered in the various parts of the mine. For mines with shallow overburden, observations should be taken for a considerable period of time to show the amount of water coming into the workings at various seasons of the year through openings or cracks in the overburden. An excellent description of the method of procedure along this line is given in the paper entitled "Run-Off and the Mine Drainage," by Mr. Howard N. Evanson, presented at the New York meeting of the American Institute of Mining and Metallurgical Engineers in February, 1921.

When this information has been assembled a close study of the topographical map of the mine should reveal the points at which it would be desirable to locate permanent pumping stations. These should be so located that as much benefit as possible is obtained from natural drainage in the mine. The pumping stations should be located at points where the water can be collected naturally either through the use of drainage ditches or siphons. In mines above drainage it may be that from these natural points of collection the water can be siphoned to the mine opening, or in cases of very large mines covering considerable area it may be that rock drainage tunnels can be driven to conduct the water from the mine. With mines below drainage and with comparatively light overburden, it is recommended that wherever possible drill holes be used in dewatering the mine so that long pipe lines may be eliminated.

In mines with deep shafts or in steeply pitching veins the water from these inside permanent pumping stations must be pumped to the shaft and from this point pumped to the surface. In such mines it is recommended that pumping stations be located at the shaft bottom or at the different levels in the shaft for lifting the water to the surface, and that the inside permanent pumping stations be equipped with pumps for transporting the water from the inside sumps to the sump or sumps at the shaft.

B.—Ventilation.—In gaseous mines permanent pumping stations should be located on the intake air and also near the return air. In order to render the ventilation of the station more effective, it is suggested that a connection with the intake air be made by inserting a pipe of adequate size through the front wall and a similar connection to the return air through the rear wall.

In non-gaseous mines the stations may be located on either the intake or return air.

In the case of gasoline pumps the exhaust should discharge into the return air, or on a separate split. Under no circumstances should the exhaust from an internal combustion engine be allowed to discharge into a current of air which circulates around the working places. For every gallon of gasoline used in a gasoline engine there should be 250,000 cubic feet of air supplied to the air current into which the engine exhausts.

In dry and dusty mines the exhaust from steam driven pumps should discharge into the intake in order to humidify the air. In no case should a steam pump be allowed to exhaust into abandoned, unventilated mine workings as this will greatly increase the danger of mine fire.

Electrically driven pumps especially should be placed in stations ventilated by fresh intake air. In gaseous mines, all

electrically driven pumps should be equipped with motors classed as "permissible" by the United States Bureau of Mines.

Open lights or torches should be prohibited in all pumping stations in which the pumps are operated by internal combustion engines.

C.—Construction of Underground Pumping Stations.—Wherever possible the pump room should be so constructed as to allow at least three feet or more of space around the pumping unit, so that ample room is allowed to make the necessary repairs. The height of the station should be such as to permit chain blocks being used to remove the heavy parts; and space be provided in or adjacent to the pump room for making ordinary repairs and storing extra parts. In the larger pumping stations it is recommended that a hand traveling crane be installed, and the repair and supply room should be served by the traveling crane. In the larger pumping stations a work bench with vise should be supplied, also cupboards or lockers, furnished with substantial locks, where all wrenches, small supplies, etc., can be kept unmolested.

D.—Type and Capacity.—No hard and fast rule can be made as to when the plunger type of pump or the centrifugal type of pump should be used. As a general recommendation, it can be stated that when the capacity is less than 300 G. P. M., the plunger type of pump is probably best suited. Above these capacities up to 750 G. P. M., either the plunger or centrifugal type may be used; the relative efficiencies and total head being the deciding factors. On pumps larger than 750 G. P. M., the centrifugal type should ordinarily be used.

In purchasing a pumping unit the following information should be given:

Capacity in G. P. M.

Total dynamic head (this to include the static head plus the friction loss in both suction and discharge piping).

Dynamic suction lift (this to consist of the difference in elevation from lowest water level in sump to top of foundation, plus friction loss in suction pipe).

For purposes of checking, the size, length and number of bends in suction and discharge piping should be given, in addition to static head and suction lift.

Information should be supplied as to the nature of the water to be handled, whether fresh, acidulous, gritty.

Purchaser should give pump builder information as to the current characteristics, viz.: whether direct current or alternating current; voltage if direct current, and voltage, phase and frequency, if alternating current.

If purchaser furnishes the motor, he should furnish one running at the speed recommended by the pump builder, and also furnish dimension leaflet.

E. Specifications for Electric Driven Plunger Pumps. *General Design.*—Pump should be of the outside packed, plunger pattern type.

Water End: The water end to be of sectionalized design as far as possible so as to minimize the cost of repairs. Water cylinders to be of cast iron or acid resisting metal. Stuffing box throat to be lined with bronze bushings. Water valves to be of suitable composition, resting on seats of bronze or other acid resisting metal. Where the water is acidulous and cast iron water ends are used, it is recommended that they be wood lined or cement lined. All water cylinders to be tapped and furnished with drain valves and air vents.

Plungers and Glands: Plungers to be of cast iron or chilled iron, except in case of acidulous water, when the plungers should be of acid resisting metal or porcelain. Plunger glands to be of cast iron or acid resisting metal.

Crank Shaft and Connecting Rods: Crank shaft and connecting rods to be of cast or forged steel. Crank and crosshead pins to be fitted with adjustable bearings. Crossheads to be provided with adjustable shoes.

Gearing: All gearing to be furnished by the pump builder, and protected by sheet iron guards so constructed as to be readily removed. It is desirable that a suitable cast iron base plate be furnished by the pump builder for supporting motor and pump frame. The main journal should be of the adjustable type.

Fittings: Pump builder to furnish a flanged relief valve, set at 20 percent in excess of discharge pressure. This valve to be large enough to discharge full pump capacity with a pressure rise on the pump not exceeding 25 percent. This valve to be installed between the pump and gate or check valve in discharge line. Vacuum and pressure gauges and full set of grease cups should be furnished.

Workmanship and Material: All castings to be clean and free from sand, dirt, or blow holes. All parts proving defective in design, workmanship or material within a period of one year from date of shipment to be replaced by the builder f. o. b. factory free of charge. All parts of the machine to be subject to the inspection and approval of purchaser's engineers, to whom full facilities should be given to test the pump at the factory before shipment is made.

General: With their proposals, pump builders should furnish purchaser the net weight of pump complete but without motor, and submit with their proposals sufficient data to form an intelligent conception of the pump. Pump builder should also state time required to furnish pump after receipt of full information regarding motor.

F.—Specifications for Centrifugal Pumps. *General Design.* Pump to be of the horizontal type, with horizontal split casing with suction and discharge connections on bottom half of casing and so designed that by removing the upper half of pump casing the whole interior of the pump is opened up and can be readily examined. Pump to be so designed that should a reversal in direction of rotation occur, from any cause, no damage will be done to the machine.

Base Plate: Pump builder to furnish heavy cast iron base plate for supporting pump and motor, to accurately align pump and motor and to place dowel pins in pump and motor bases so that they cannot get out of alignment.

Pump Casing: In general, it will be found economical to use pump casings made of acid resisting materials. If the water is known to be pure fresh water, however, casings can be made of cast iron. Since water containing an excessive amount of grit works a hardship on pumping apparatus, it is advisable to build sumps of a capacity large enough to settle out the grit as much as possible.

In order to minimize repairs, the casing should be fitted with suitable wearing rings, locked into position. The use of screws or dowel pins is objectionable for this purpose. All high spots of the casing to be tapped and furnished with suitable cocks for air vents. Suitable cocks shall also be furnished for draining all water from the casing.

Impellers: Impellers to be of the enclosed type and made from acid resisting metal.

Stuffing Boxes and Glands: Stuffing boxes to be deep enough to take not less than four rings of packing after allowing glands to project one-half inch into stuffing box; to be provided with renewable bronze neck rings or bushings. Each stuffing box to be provided with a water seal ring, with water supply for same. Glands to be of bronze, made in halves; gland to be snug fit in stuffing boxes, but bored out slightly larger than shaft to insure glands from riding or rubbing on shaft.

Shaft: Pump shaft to be of liberal proportions, and to be of acid resisting metal or protected where it comes in contact with the water. The shaft with its impeller, rings and couplings, to be perfectly balanced before being placed in the pump.

Couplings: Pump builder to furnish all couplings; these couplings to be of the flexible type where attached to motor.

Bearings: Pump builder to furnish bearings of proper size and type, guaranteed to run cool 24 hours under full load. Bearing to be split and accurately fitted to cast iron boxes with bolted caps, the whole so arranged that the bearings can be removed, re-babbitted, or renewed without disturbing the shaft or other parts of the pump. Each bearing box is to form a liberal oil well; to be provided with gauge glasses or overflows; also plugs for draining. Suitable washers or collars to be fitted on end of shaft to prevent water or dust from working into bearings.

Fittings: Each pump to be installed with water pressure gauge and vacuum gauge. Pump builder shall furnish all necessary fittings; circulating pipes when thrust bearings are furnished.

General: All material and workmanship to be the best of their respective kinds. All casting to be free from sand, dirt, or blow holes, and to be smooth on the inside as well as on the outside. All parts proving defective in design, material or workmanship within a period of one year after date of shipment to be replaced by the builder f. o. b. factory free of charge.

Suction and Discharge Piping: The suction piping should be as direct and short as possible. It should be at least one or two sizes larger than pump nozzle. Length and size is determined by the maximum allowable suction lift. Where changing from one pipe size to another, standard A. S. M. E. suction reducer should be used. Pipe should be laid out so that air pockets are eliminated. It should be tested with pressure for leaks.

To protect the pump, a check valve should be installed in discharge line close to the pump. Size of discharge line to be determined by length of line and capacity to be handled.

Motors and Control: For type of motor and control to be used, consult recommendations of Power Equipment Section of the Standardization Committee.

Motor and Coupling Shield: To protect the motor from any leakage caused by the blowing out of gasket, packing, etc., on pumps, also to prevent accident to operator from being caught in revolving coupling, a suitable sheet iron guard to be furnished by the pump builder. Guard to consist of a vertical shield, not less than No. 16 gauge thick; to be full width of motor base, to have semi-circular top and placed around pump shaft between inner bearing box on pump and hub of pump coupling, with a circular hood built on back of shield to entirely encase couplings; the whole to be split vertically with halves bolted together and to be rigidly connected to base plate, but so arranged as to readily be removed.

Coating: Inside of casing and impeller to be painted with two coats of Highland's non-corrosive paint, or other approved acid resisting coating.

Pump Accessories: Each reciprocating pump should be provided with a "speed counter" for determining the capacity delivered. Owing to the variable amount of slippage due to leaky valves or packing, on plunger pumps this method of measuring the amount of water handled will give only approximate results. To secure an accurate record of water handled, a Weir with glass notch should be installed at each sump at the point where the water enters. A recording mechanism with a 24-hour chart, calibrated for each Weir, may be secured from the various recording gauge companies.

Large plunger pumps should be equipped with suitable force-feed oiling devices. If a sufficient number of pumps are in continuous operation in each station an oil filtering system should be provided.

By-pass valves should be installed on each plunger pump in order to reduce the starting load, if squirrel cage type induction motors are used. It is desirable to have a by-pass valve on each plunger pump which is used as a main pumping unit to determine the action of the valves when in operation.

Check valves should be placed on the discharge side of each pump where two or more pumps discharge into a common column line. On small size plunger pumps having one column to each pump, the expense of a check valve can be eliminated.

Gate valves should be installed on centrifugal pumps when two or more pumps discharge into a common column line and it is desirable to have a gate valve on all centrifugal pumps. Such valves are necessary when starting pumps driven by synchronous motors and squirrel cage induction motors with low starting torque. Gate valves should be located between the check valve and column line. When two or more column lines are arranged for use with a number of centrifugal pumps, gate valves should be used for cutting in and out the various column lines for repairs. For draining column lines a small gate valve can be connected to a blow-off flange located at a suitable low point.

Suction strainers should be installed on the suction pipes of all pumps to prevent solids from entering the pumps. It is recommended that the strainer be installed in the suction line at or near the pump rather than on the end of the line in the sump. If installed in this manner foreign matter may be removed at any time without entering the sump.

Pressure gauges should be installed on the discharge pipe of each pump for determining the pressure at which each unit is operating. Vacuum gauges should be installed in the suction pipe of each centrifugal pump. A combination vacuum and pressure gauge should be used instead of a straight vacuum gauge if there is a positive pressure on the pump suction.

Small plunger pumps should be provided with air chambers on the suction and discharge sides of the pump to compensate for variations in flow due to velocity changes. Large high head plunger pumps should be equipped with alleviators on the discharge side and air chambers on the suction side of the pump. Either spring type or rubber buffer type of alleviators may be used.

Centrifugal pumps may be primed by means of air, steam or water ejectors, or by vacuum pumps. Each pumping casing should be provided with a bronze priming valve, Plunger pumps should be provided with bronze priming valves located on the suction chamber. The water ends of the pumps should be filled with water before starting.

To prevent damage to the internal wearing parts of centrifugal pumps in case they suddenly lose water, a special pressure gauge may be mounted on the first stage of the casings. This gauge should be equipped with electrical circuit closing contacts which are wired in series with the under-voltage release on the motor starter. If the pressure is lost in the pump casing, the gauge will close the electrical circuit, thus stopping the motor. A normally open push button on the motor panel is used to short circuit the contacts on the special gauge while starting the motor.

Centrifugal pumps equipped with an hydraulic balancing disc have the balancing disc chamber connected by a small bronze pipe to the pump suction. If this pipe becomes clogged and prevents the flow of water, the balancing disc does not function and the pump may be damaged due to loss of thrust protection. To prevent this a sight flow indicator should be placed in the circulating water pipe so that the operator can see at a glance that the proper flow of water is maintained.

Sump and Column Line: Large sump capacity is not generally practical, but sufficient water storage space should be obtained so as to keep the pump in as nearly constant operation as possible.

Where head conditions are adapted to same, centrifugal pumps are recommended due to their economy of space and simplicity of working parts. Where electric power source is unreliable and when pumps are located within the limits of economical steam transmission the use of steam pumps is considered good practice. It must be remembered, however, that use of steam pumps, unless compounded is very wasteful. Where both steam and electricity are obtainable, if danger from interruption is sufficiently grave, units may be so selected as to make either source of power available for pumping.

Each pumping station should be provided with a sump of sufficient size to properly care for the water. It is of utmost importance that reserve capacity be provided in case of breakdown of the pumps. It is recommended that all sumps be sufficiently large to care for at least a day's supply with the pumps not working.

At the shaft bottom in new mines working horizontal coal seams, the main sump should be excavated under the coal seam at one end of the shaft. The bottom of this sump should be below the bottom of the cage seats and the sump be separated from the shaft by a concrete wall to prevent coal falling into the sump. Screened openings in this wall at the bottom of the shaft should permit the water to flow into the sump. This sump should be excavated under the coal seam, the area and depth depending both upon the amount of water to be handled and upon the strata beneath the coal. In some cases it may be necessary to line this sump with concrete to prevent the water seeping away through the mine bottom.

With such sumps, the pumping station may be made in the coal seam directly over the sump, a concrete slab being put in for a pump room floor. In case the sump is so large that this is inadvisable, the pumping station may be excavated in the coal above and at one side of the sump. The size of this sump will depend not only on the amount of water made in the shafts but upon the depth to the coal seam. In deep mines all mine water will be handled through this sump but in shallow mines most of the water may be removed through bore holes.

Sumps for inside pumping stations may be constructed along the entries in the same manner as outlined above. In mines working seams that have more or less pitch, advantage is often taken of abandoned portions of the mine for sumpage purposes. This is especially true with mines having shallow overburden which are subject to heavy inrushes of water during flood seasons. Occasionally portions of a mine are laid out and worked with the intention of later using the workings as an emergency sump. Such an arrangement often equalizes the pumping requirements at a mine and is recommended wherever practicable.

In mines with steeply pitching veins, when building new sumps in rock, tunnels should be driven at right angles if possible to the coal seams to prevent rock slippage and costly timbering for keeping the sumps open. The roof of the sump should be at approximately the same elevation as the pump-room floor. The cross section of sump tunnels should be seldom smaller than 8 feet square due to blasting requirements, and may be 10 to 12 feet square if the rock formation will hold. Steel timbering and concrete lining may be necessary, and if used the wood forms should be left in place as the acid water when in motion disintegrates the concrete and attacks the iron.

Sumps should be located as near the pump room as possible so that the pump suction pipes can be short, and thus eliminate air pockets in the pipes. This is very important when centrifugal pumps are used. Depths beyond 20 feet are not of much value, and to provide for large volumes of water the area must be increased. In no case should a main intake or return air course be used for storing water.

When building new sumps of large capacity, an inclined opening with mine car tracks to the bottom of the sump is of great advantage for clearing out foreign matter which may eventually fill the sump and thus reduce its capacity. Sumps located in the pump room should be covered with reinforced concrete and

provided with man-holes for cleaning and repairs. At points where the water enters the sump suitable screens should be installed to prevent refuse from entering the sump and eventually clogging up the pumps. If possible sumps should be made in two sections so that either section may be cleaned without shutting down the complete pumping plant. All ditches feeding the sumps should have small dams built at suitable intervals to collect sand, small pieces of coal, rock and wood. The ditches can be cleaned out as they become filled and by having screens at the sump entrance all foreign matter can be kept out of the pumps.

The sump storage of old mines was usually made in abandoned coal workings and sometimes in rock or in both coal and rock. Most of these sumps were very deep with but little horizontal area. Little attention was paid to provision for cleaning the sumps or preventing foreign matter from entering same as the old steam driven plunger pumps handled solids along with the water. Since the adoption of electrically driven centrifugal pumps, more attention is being given to keeping the sumps clean, and to enlarging them for greater capacity when possible.

Many operators are endeavoring to use large areas of abandoned workings for water storage during flood water seasons and gradually tapping off the water during low water seasons, thus saving enormous expenditures for pumps and column lines necessary only a few weeks during the flood season. This arrangement should be given very serious consideration since the amount of water to be handled usually continues to increase as the mines are extended.

STANDARD PRACTICE IN PRIMING PISTON, PLUNGER AND CENTRIFUGAL PUMPS, SEMI-REMOTE CONTROL, SAFETY PRECAUTIONS AND ATTENDANCE.

Priming of Pumps: Few pumps can be depended upon to pick up water and prime themselves when absolutely dry, and where there is very much suction lift, especially where the pump is to de-

Friction of Water in Pipes.

Loss of Head in Feet Due to Friction, per 100 Feet of Ordinary Iron Pipe.

Gal's per Min.	¾" Pipe		⅘" Pipe		⅚" Pipe		¾" Pipe		1" Pipe		1¼" Pipe		1½" Pipe		2" Pipe		2½" Pipe		3" Pipe	
	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.
1	3.06	28.0	1.67	8.4	1.08	3.1														
2	6.18	103.0	3.35	23.3	2.16	7.4	1.20	1.9												
3	....	....	5.03	49.0	3.16	15.0	1.80	4.1	1.13	1.29										
4	....	....	6.70	84.0	4.31	27.0	2.41	7.0	1.49	2.14	0.86	0.87	0.63	0.26						
5	....	....	8.37	128.0	5.38	41.0	3.01	10.5	1.88	3.25	1.07	0.84	0.79	0.39						
10	....	....	....	....	10.62	147.0	6.02	38.0	3.72	11.7	2.14	3.06	1.57	1.43	1.03	0.80	0.65	0.17	0.45	0.07
15	....	....	....	....	....	....	9.02	80.0	5.60	25.0	3.3	6.60	2.36	3.0	1.53	1.0	0.98	0.36	0.68	0.15
20	....	....	....	....	....	....	12.03	136.0	7.44	42.0	4.29	11.1	3.15	5.2	2.04	1.82	1.31	0.61	0.91	0.25
25	....	....	....	....	....	....	....	....	9.30	64.0	5.38	18.0	3.94	7.8	2.55	2.73	1.63	0.92	1.13	0.38
30	....	....	....	....	....	....	....	....	11.15	89.0	6.43	23.5	4.72	11.0	3.06	3.84	1.96	1.29	1.36	0.54
35	....	....	....	....	....	....	....	....	13.02	119.0	7.51	31.3	5.51	14.7	3.57	5.1	2.29	1.72	1.59	0.71
40	....	....	....	....	....	....	....	....	14.88	152.0	8.58	40.0	6.3	18.8	4.08	6.6	2.61	2.20	1.82	0.91
50	....	....	....	....	....	....	....	....	....	....	10.73	60	7.87	28.4	5.11	9.9	3.27	3.33	2.27	1.38
60	....	....	....	....	....	....	....	....	....	....	12.87	83	9.45	39.8	6.13	13.8	3.92	4.6	2.73	1.91
70	....	....	....	....	....	....	....	....	....	....	15.01	113	11.02	53.0	7.15	18.4	4.58	6.2	3.18	2.57
80	....	....	....	....	....	....	....	....	....	....	....	....	14.17	84.0	9.19	29.4	5.88	9.8	4.09	4.08
100	....	....	....	....	....	....	....	....	....	....	....	....	15.74	103.0	10.21	33.8	6.54	12.0	4.54	4.98
120	....	....	....	....	....	....	....	....	....	....	....	....	18.89	143.0	12.25	50.0	7.84	16.8	5.45	7.0
140	....	....	....	....	....	....	....	....	....	....	....	....	22.04	190.0	14.30	67.0	9.18	22.3	6.36	9.3
160	....	....	....	....	....	....	....	....	....	....	....	....	....	....	16.34	86.0	10.46	29.0	7.26	11.8
180	....	....	....	....	....	....	....	....	....	....	....	....	....	....	18.38	107.0	11.76	35.7	8.17	14.8
200	....	....	....	....	....	....	....	....	....	....	....	....	....	....	20.42	129.0	13.07	43.1	9.08	17.8
220	....	....	....	....	....	....	....	....	....	....	....	....	....	....	22.47	154.0	14.38	52.0	9.99	21.3
240	....	....	....	....	....	....	....	....	....	....	....	....	....	....	24.51	182.0	15.69	61.0	10.89	25.1
260	....	....	....	....	....	....	....	....	....	....	....	....	....	....	26.55	211.0	16.99	70.0	11.80	29.1
280	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	18.30	81.0	12.71	33.4
300	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	19.61	92.0	13.62	38.0

Vel.—Velocity ft. per second. Fric.—Friction head in feet.

Friction of Water in 90° Elbows.

Equivalent Number of Feet Straight Pipe.

Size of Elbows, Inches	¾	⅘	1	1¼	1½	2	2½	3
Friction Equivalent Feet Straight Pipe	3	4	5	6	8	8	8	11	15

Friction of Water in Pipes

Loss of head in feet due to friction per 100 feet of ordinary cast iron pipe

Gal's per Min.	4" Pipe		5" Pipe		6" Pipe		8" Pipe		10" Pipe		12" Pipe		14" Pipe		15" Pipe		16" Pipe		20" Pipe	
	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.
40	1.02	0.22																		
45	1.17	0.28																		
50	1.28	0.34																		
70	1.79	0.63	1.14	0.21																
75	1.92	0.73	1.22	0.24																
100	2.55	1.23	1.63	0.39	1.14	0.14														
120	3.06	1.71	1.96	0.57	1.42	0.23														
125	3.19	1.86	2.04	0.64	1.48	0.28														
150	3.84	2.55	2.45	0.88	1.71	0.32														
175	4.45	3.36	2.86	1.18	2.00	0.46														
200	5.11	4.37	3.27	1.48	2.28	0.62														
225	6.32	6.61	3.67	1.86	2.57	0.74														
250	6.40	6.72	4.08	2.24	2.80	0.92	1.60	0.22												
270	6.90	7.70	4.42	2.60	3.03	1.13	1.70	0.25												
275	7.03	7.99	4.50	2.72	3.09	1.15	1.73	0.27												
300	7.66	9.38	4.90	3.15	3.40	1.29	1.90	0.36												
350	8.90	12.32	5.72	4.19	3.94	1.69	2.20	0.41												
400	10.20	15.82	6.54	5.33	4.54	2.21	2.60	0.56												
450	11.50	19.74	7.35	6.65	5.12	2.74	2.92	0.64	1.80	0.21										
470	12.16	22.40	7.78	7.42	5.49	3.12	3.07	0.77	1.92	0.24										
475	12.30	22.96	7.88	7.22	5.55	3.21	3.10	0.79	1.94	0.25										
500	12.77	24.69	8.17	8.12	5.80	3.26	3.20	0.81	2.04	0.28	1.42	0.11								
550	....	....	8.99	9.66	6.16	3.93	3.52	0.98	2.25	0.33	1.57	0.14								
600	....	....	9.80	11.31	6.72	4.70	3.84	1.16	2.46	0.39	1.71	0.15								
650	....	....	10.62	13.16	7.28	5.50	4.16	1.34	2.66	0.46	1.85	0.19	1.37	.09						
700	....	....	11.44	15.12	7.84	6.38	4.46	1.54	2.86	0.52	2.00	0.22	1.47	.10						
750	....	....	12.26	17.22	8.50	7.00	4.80	1.74	3.06	0.59	2.13	0.24	1.58	.11						
800	....	....	....	....	9.08	7.90	5.12	1.97	3.28	0.67	2.27	0.27	1.69	.13						
850	....	....	....	....	9.58	8.75	5.48	2.28	3.49	0.75	2.41	0.31	1.79	.14						
900	....	....	....	....	10.30	10.11	5.75	2.46	3.68	0.83	2.56	0.34	1.89	.16						
950	....	....	....	....	10.72	10.71	6.06	2.87	3.88	0.91	2.70	0.35	2.00	.16	1.73	.12				
1000	....	....	....	....	11.32	12.04	6.40	3.02	4.08	1.01	2.84	0.41	2.10	.19	1.82	.14				
1050	....	....	....	....	11.90	13.30	6.79	3.21	4.29	1.09	2.98	0.48	2.20	.22	1.91	.16				
1100	....	....	....	....	12.50	14.31	7.03	3.51	4.50	1.20	3.13	0.49	2.31	.23	2.00	.16				
1150	....	....	....	....	12.95	15.34	7.35	3.84	4.71	1.34	3.27	0.53	2.42	.25	2.09	.17				
1200	....	....	....	....	13.52	16.69	7.67	4.26	4.91	1.46	3.41	0.57	2.52	.26	2.18	.19				
1250	....	....	....	....	14.10	18.20	8.00	4.45	5.11	1.51	3.55	0.62	2.63	.29	2.28	.20	1.99	0.15		
1500	....	....	....	....	....	....	9.60	6.27	6.10	2.09	4.20	0.85	3.15	.39	2.73	.28	2.39	0.24		
2000	....	....	....	....	....	....	12.70	10.71	8.10	3.50	5.60	1.43	4.20	.65	3.64	.47	3.19	0.39		
2500	....	....	....	....	....	....	....	....	10.10	5.33	7.00	2.18	5.25	1.01	4.55	.72	3.99	0.56		
3000	....	....	....	....	....	....	....	....	12.10	7.42	8.40	3.39	6.30	1.57	5.46	1.12	4.79	0.80	3.06	0.27
3500	....	....	....	....	....	....	....	....	14.10	10.08	9.80	3.92	7.35	1.82	6.37	1.29	5.59	1.04	3.59	0.35
4000	....	....	....	....	....	....	....	....	....	....	11.35	5.32	8.40	2.47	7.28	1.76	6.38	1.34	4.10	0.45
4200	....	....	....	....	....	....	....	....	....	....	11.93	6.30	8.82	2.92	7.64	2.08	6.72	1.45	4.32	0.50
4500	....	....	....	....	....	....	....	....	....	....	12.78	6.75	9.45	3.18	8.19	2.23	7.20	1.65	4.62	0.56
5000	....	....	....	....	....	....	....	....	....	....	14.20	8.15	10.50	3.78	9.10	2.69	7.96	2.02	5.13	0.68
5500	....	....	....	....	....	....	....	....	....	....	....	....	11.55	4.50	10.01	3.16	8.78	2.39	5.64	0.82
6000	....	....	....	....	....	....	....	....	....	....	....	....	12.60	5.40	10.92	3.79	9.56	2.84	6.15	0.96
6500	....	....	....	....	....	....	....	....	....	....	....	....	13.65	6.14	11.83	4.30	10.36	3.32	6.66	1.01
7000	....	....	....	....	....	....	....	....	....	....	....	....	14.70	6.65	12.74	4.68	11.12	3.68	7.18	1.28
7200	....	....	....	....	....	....	....	....	....	....	....	....	....	....	13.10	4.95	11.50	3.96	7.38	1.35
7500	....	....	....	....	....	....	....	....	....	....	....	....	....	....	13.65	5.60	11.92	4.28	7.66	1.45
8000	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	8.17	1.63
8500	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	8.68	1.83
9000	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	9.20	2.04
9500	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	9.70	2.23
10000	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	10.40	2.53

Vel.—Velocity ft. per second. Fric.—Friction head in feet.

Friction of Water in 90° Elbows

Equivalent Number of Feet Straight Pipe

Size of Elbow, Inches	4	5	6	8	10	12	14	15	16	20
Friction Equivalent Feet Straight Pipe	16	18	18	24	30	40	54	55	58	70

NOTE—The figures given are based on the assumption that the total velocity head of the water flowing through the elbow is used up to overcome the friction.

Friction of Water in Pipes

Loss of head in feet due to friction per 100 feet of ordinary cast iron pipe.

Gal's per Min.	24" Pipe		30" Pipe		36" Pipe		42" Pipe		48" Pipe	
	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.	Vel.	Fric.
2000	1.42	0.05								
2500	1.77	0.07								
3000	2.13	0.10								
3500	2.49	0.14	1.56	0.04						
4000	2.85	0.18	1.81	0.06						
4500	3.20	0.22	2.04	0.08						
5000	3.54	0.27	2.26	0.09						
5500	3.90	0.33	2.50	0.11						
6000	4.25	0.38	2.72	0.13	1.90	0.03				
6500	4.61	0.45	2.95	0.15	2.05	0.06				
7000	4.97	0.53	3.18	0.17	2.21	0.07				
7500	5.32	0.59	3.42	0.20	2.37	0.08				
8000	5.68	0.66	3.63	0.22	2.53	0.09				
8500	6.03	0.74	3.86	0.25	2.69	0.10				
9000	6.35	0.81	4.08	0.27	2.84	0.11				
9500	6.74	0.91	4.31	0.30	3.00	0.12				
10000	7.07	0.98	4.54	0.33	3.14	0.13	2.31	0.06		
10500	7.45	1.10	4.76	0.37	3.26	0.14	2.43	0.06		
11000	7.80	1.20	5.00	0.40	3.46	0.16	2.55	0.07		
11500	8.18	1.29	5.21	0.43	3.62	0.18	2.65	0.08		
12000	8.50	1.40	5.44	0.47	3.77	0.19	2.77	0.09		
12500	8.86	1.53	5.67	0.51	3.94	0.21	2.89	0.09		
13000	9.22	1.63	5.91	0.54	4.10	0.22	3.00	0.10		
13500	9.60	1.75	6.13	0.58	4.27	0.24	3.12	0.11		
14000	9.95	1.87	6.36	0.63	4.43	0.26	3.23	0.12		
14500	10.3	2.00	6.61	0.68	4.59	0.27	3.35	0.13	2.57	0.06
15000	10.63	2.12	6.81	0.72	4.76	0.29	3.47	0.14	2.66	0.07
16000	11.38	2.40	7.26	0.83	5.05	0.33	3.71	0.15	2.87	0.08
17000	12.09	2.70	7.73	0.91	5.38	0.37	3.94	0.17	3.02	0.09
18000	12.78	2.97	8.18	1.00	5.67	0.41	4.16	0.19	3.19	0.10
19000	13.50	3.26	8.66	1.11	6.00	0.45	4.40	0.21	3.37	0.11
20000	14.20	3.60	9.09	1.22	6.30	0.50	4.63	0.23	3.54	0.12
21000	14.90	3.96	9.54	1.34	6.62	0.55	4.85	0.26	3.71	0.13
22000	....	....	10.0	1.47	6.93	0.60	5.10	0.28	3.90	0.14
23000	....	....	10.45	1.59	7.24	0.65	5.32	0.30	4.08	0.15
24000	....	....	10.9	1.71	7.54	0.70	5.55	0.32	4.26	0.17
25000	....	....	11.35	1.85	7.88	0.76	5.79	0.35	4.43	0.18
26000	....	....	11.80	1.97	8.20	0.82	6.03	0.38	4.61	0.20
27000	....	....	12.26	2.12	8.53	0.87	6.28	0.41	4.78	0.21
28000	....	....	12.73	2.28	8.85	0.94	6.51	0.44	4.96	0.23
29000	....	....	....	....	9.17	1.00	6.71	0.47	5.14	0.24
30000	....	....	....	....	9.45	1.05	6.98	0.50	5.33	0.26
32000	....	....	....	....	10.10	1.19	7.42	0.56	5.67	0.29
34000	....	....	....	....	10.75	1.33	7.88	0.63	6.03	0.33
36000	....	....	....	....	11.38	1.49	8.32	0.70	6.39	0.37
38000	....	....	....	....	12.00	1.65	8.80	0.77	6.75	0.40
40000	....	....	....	....	12.62	1.81	9.29	0.85	7.11	0.44
42000	....	....	....	....	13.25	1.99	9.75	0.93	7.48	0.49
44000	....	....	....	....	....	....	10.18	1.01	7.80	0.53
46000	....	....	....	....	....	....	10.62	1.10	8.14	0.58
48000	....	....	....	....	....	....	11.10	1.19	8.52	0.62
50000	....	....	....	....	....	....	11.58	1.29	8.88	0.67
52000	....	....	....	....	....	....	12.05	1.38	9.21	0.73
54000	....	....	....	....	....	....	12.50	1.48	9.55	0.77
56000	....	....	....	....	....	....	12.94	1.59	9.9.	0.83
58000	....	....	....	....	....	....	....	....	10..7	0.88
60000	....	....	....	....	....	....	....	....	10.60	0.94
62000	....	....	....	....	....	....	....	....	10.98	1.01
64000	....	....	....	....	....	....	....	....	11.35	1.07
66000	....	....	....	....	....	....	....	....	11.69	1.13
68000	....	....	....	....	....	....	....	....	12.03	1.19
70000	....	....	....	....	....	....	....	....	12.41	1.26

Vel.—Velocity ft. per second. Fric.—Friction head in feet.

Friction of Water in 90° Elbows

Equivalent Number of Feet Straight Pipe

Size of Elbows, Inches	24	30	36	42	48
Friction Equivalent Feet Straight Pipe	80	100	120	140	160

NOTE—The figures given are based on the assumption that the total velocity head of the water flowing through the elbow is used up to overcome the friction.

liver water into a line already under pressure. It is therefore absolutely necessary in some cases, and is always desirable to see that pumps are carefully primed before starting.

(a) *Piston and Plunger Pumps:* If pump to be started is new or has not been operated for some time, all suction and discharge valves should be lifted from their seats to make sure that each will operate freely—then with the discharge valve cover plates removed, lift one discharge valve in each chamber and fill the cylinder and valve ports in that chamber entirely full of water. Replace all cover plates and after seeing that there is a free outlet to the atmosphere, start pump and run until all air is pumped out and clear solid water is delivered. Pump is then ready to operate under regular conditions. It is seldom necessary to repeat this priming operation, although it is always good practice to have the discharge line connected up to include a Tee with valve or cock so that at any time the pump can be operated against atmospheric pressure only and to make sure that all cylinders and valves are working properly.

(b) *Centrifugal Pumps:* Since a centrifugal pump together with its entire suction line, must be wholly free from air, priming is of great importance and a positive method must be adopted.

1. Never try to prime a centrifugal pump while it is in motion.

2. Always use a good strainer on the suction intake.

3. Priming by use of foot valve.

Where pump is in low lift service a plain combined foot valve and strainer may be used on the suction intake pipe and water poured into an opening provided for the purpose. A pet cock should be screwed into the highest point of the pump shell and kept open until all air is expelled. Pet cocks should also be screwed into any high spots in the suction line where air would be trapped. When water flows freely from highest pet cock, pump is then primed and should be started immediately. It should be remembered that a centrifugal pump will seldom operate against a pressure when air gets into the pump either through the suction pipe or the stuffing box or any other place. When pump is to operate on a high head, a very dangerous pressure may be developed in the pump shell and suction pipe and fittings when pump is stopped by the resulting back surge of the water. Pumps under these conditions should therefore be protected by a swing check valve on the discharge and a By-Pass put in to run water from the discharge back through the pump into the suction, otherwise proceed as under low head conditions.

Priming Without Use of a Foot Valve: It is often very desirable to eliminate entirely the use of a foot valve, in which case the pump would be primed by exhausting all air from the pump and suction line, using a check valve or gate valve or both in the discharge line near pump to prevent any air from coming in through the discharge connection. In order to get an air tight shut-off it might be necessary if pump has been out of use for a while to run some water in the discharge to seal the valve.

To Exhaust the Air: (a) When pump and connections are comparatively small, connect the suction of a small pitcher spout pump or any good hand pump including the horizontal double acting type, to the highest point of pump shell. Prime the hand pump with a very small quantity of water and operate until all air is exhausted and clear water is delivered. Then close valve in suction connection to top of pump shell and start centrifugal immediately. Remember that a centrifugal pump can be started or operated a short time without injury against a closed line where, in the case of a reciprocating pump, something would be sure to break.

(b) By the use of a small double acting motor driven piston pump connected to top of pump shell the same as with hand pump.

(c) By the use of a steam ejector, if steam is available, connect suction of ejector to top of pump shell with valve or cock and operate until pump is primed and proceed as above.

(d) By the use of a hydraulic ejector used the same as steam ejector provided water under a pressure of 20 pounds or more can be obtained. Sometimes there is sufficient water stored in the discharge line beyond the check valve to properly prime a pump by the hydraulic ejector, in which case a hand pump as under (a) should also be installed to have a positive method available.

(e) By use of hydraulic ejector operated by a small auxiliary direct connected motor driven pump taking water from the bottom of a barrel and discharging about 40 to 50 gallons per minute at 20 pounds pressure through the ejector back into the same barrel.

Semi-Remote Control: A switch should be placed in the main feed line, or where it will open the starting-device circuit, so that in cases of emergency the operator may open the circuit, without subjecting himself to danger from flying pieces in case of breaking a connecting rod, gear or other part.

Safety Precautions: Rapidly moving parts of all motors and pumps should be so guarded that the hazard of injury from them shall be reduced to the minimum.

Wiring to the station and within the station should be in accordance with the rules recommended in underground power transmission and power equipment.

Every pumping station should be well lighted and the sides should either be painted white or whitewashed, so that the operator of the pumps can plainly see what he is doing.

No person carrying or wearing an open light should enter or be allowed in any pumping station in which an internal combustion engine is used.

No more than five gallons of gasoline should be stored at one time in any one pumping station and then it must be carried and kept in a metal container, securely locked.

All gears to be enclosed or completely guarded.

No projecting keys or set-screws to be used on revolving parts. Self-oiling bearings recommended wherever possible.

Enclosed motors preferred.

Motors up to 7½ h. p., a. c. or d. c., should be self-starting, with enclosed switch.

For larger motors, enclosed rheostats or compensators preferred.

Voltage not exceeding 250 d. c., or 220 a. c., recommended for underground work, except for large motors (over 150 h. p.) where 440 a. c. is recommended, in which case, as with 500-volt d. c. system conduit wiring is urged.

All gears to be enclosed or completely guarded.

Attendance.—*We recommend:*

Definite fixing of responsibility for the operation, care, and inspection of each piece of pumping machinery in such a manner that same will be insured of proper attendance at regular intervals, and will not be forced to rely on haphazard attention delegated to whoever happens to be in the vicinity at convenient times.

More careful selection of pump attendants and believe that more stress should be laid upon a man's fitness for the job, and that the operating of mine pumps should be not regarded as a system of pensioning men unfit for more useful work as is often the case at present.

Equipping mine pumpers with proper tools for the work they are required to do and the adoption of systematic methods for making them responsible for these tools. This we believe will in many cases prevent damage from the use of makeshift tools or from bolts, nuts, valve covers, etc., which work loose, not being properly tightened.

NATURAL DRAINAGE

Location and Advantages of Drainage Ditch.—It is necessary to give careful study to mine levels in order to determine if water can be more economically removed by ditching and natural drainage. Sometimes several bodies of water can be collected by ditching and brought to a central point for disposal.

As a rule ditching is expensive in initial cost; but when such a system is properly provided, the maintenance expense is very low and the operating expense is practically nil.

Ditch drainage, wherever possible, is more reliable in operation than mechanical drainage, and continues without cost of power or attendance, which are distinct advantages in its favor.

Where a ditch system has been provided to drain numerous collections of water to one point, it permits the use of bore holes to the surface and thus eliminates long pipe lines in the mine, which are a source of constant expense in that the life of such pipe lines is problematical, and same are subject to breaks, due to slate falls.

Permanent grades should be established and clearly marked on the rib every 25 feet unless the drainage ditch has considerable fall, in which case every 50 feet should be sufficient. A good method to indicate brades for a drainage ditch system is to drive wooden plugs into the rib to receive suitable nails, marking the distance from such nails to the bottom of the ditch. If the ditch is to be deep, it would be well to lay tile along the deep sections and refill the ditch over the tile; but if the ditch does not exceed 5 feet in depth, and is not extended along a manway or haulways and the bottom is firm, it may be left open. When tile is placed in the ditch it is good practice to install manholes at intervals along its length of 50 to 100 feet. The manholes are provided to facilitate cleaning out the drain from obstructions or stoppages.

Where ditches must be placed along main haulways or airways at a depth exceeding two feet, they should be tiled and refilled.

Surface ditches outside of the coal measures are employed to divert surface drainage water, so as to prevent it entering the mine, and there are cases where creeks have been advantageously

so diverted. Mining operations are sometimes conducted under extensive areas of saturated sands and gravels, and it has been found desirable in some cases to leave chain pillars to hold up the surface and prevent leakage into the mine. Where the workings are above the drainage level of the entry, tunnels are sometimes driven for a considerable distance to the outside, in order to drain the entire working area.

When the workings are below the drainage level (which is the common condition now, and will be more so in the future as the workings are continually being extended to lower levels), it is desirable to retain the water on the upper levels as long as possible in order to reduce the pumping head. To do this, sufficient barrier coal is left standing in the operations at lower levels.

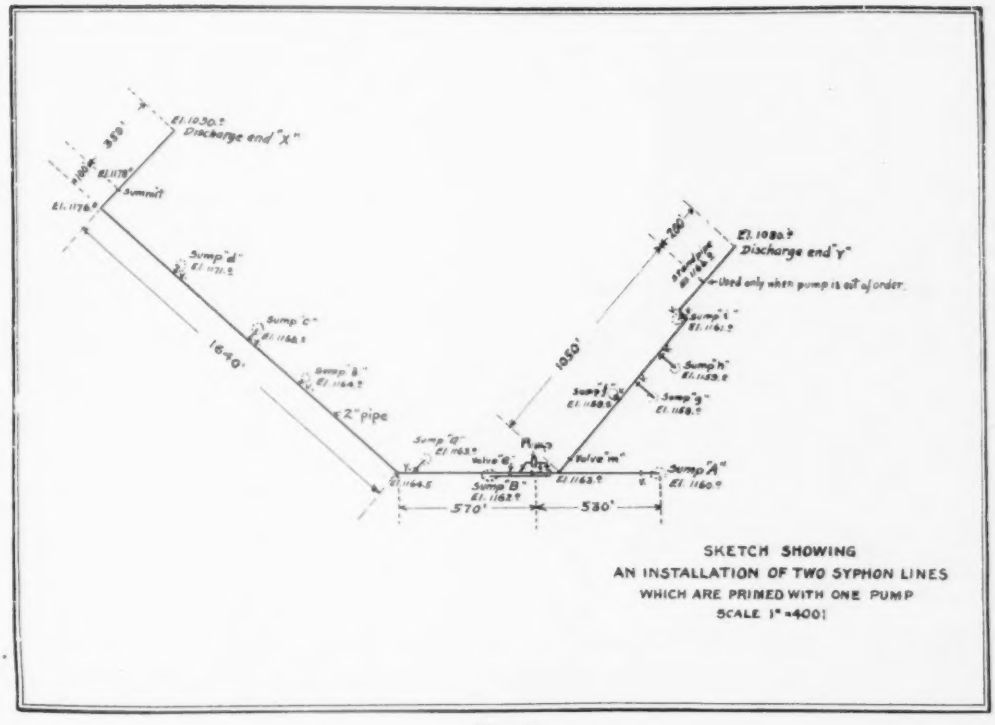


Fig. 39

Ditching can be employed to advantage to collect the water from several sources to one central point in the mine, and from this point pumped to the surface by a large economical pumping unit, thus eliminating the necessity for the installation of many small pumping units.

Tunnels and gangways are usually carried on 0.5 percent to 0.75 percent grade. While the lighter grade is better adapted for haulage purposes, the heavier grade is common in ditching along the track in order to carry away large volumes of water.

Sometimes abandoned workings below the level of the pumps are utilized to hold some of the water during flood seasons, and then during periods of low water small pumps are used to raise the accumulated excess to upper levels, where it drains to the sumps of the main pumping station.

Deep sumps below the main pumping stations are not of much value unless extended over a very large area because of the limited height water can be lifted by pumps.

Where storage for water cannot be provided as above mentioned, it may be necessary during flood periods to hastily construct dams of concrete, brick, or earth filled timbers across certain of the openings, and the water thus held back in the workings, which must be temporarily abandoned until flood conditions cease. This practice is undesirable because of curtailed production during the interim, and it may prove to be more economical to invest in proper and ample pump capacity to take care of such conditions.

In the course of development of mining operations, it frequently happens that the work advances toward abandoned sections of previous mining operations where there is known to be, or where there is likely to be a large body of standing water. In such cases extreme care must be exercised to keep bore holes well in advance of actual excavations in order to tap such water and prevent a sudden flooding which would otherwise occur, and which might end in disastrous consequences.

The main entries, wherever possible, should always be driven slightly to the rise, so that the greatest possible area of the mine will be drained by gravity toward the main opening or to a centralized sump.

The main haulage road should be on the up-side of the airway following it, and the drainage ditch should preferably be located in the airway. Thus, the main haulage may be more easily maintained and kept dryer, and any sudden inrush of water causing the flooding of the ditch, will result in less difficulty. Likewise, the workings to the dip of the drainage ditch will be better protected. The drainage ditch in this position provides a place into which the water encountered in the dip workings can be discharged until a better method is installed. It also prevents the water from the high side of the mine from entering into the dip workings.

Wet rails on the haulage system are a continual source of trouble, and this condition should be avoided. This is usually the case when small sumps are installed along the main haulage road. By proper ditching and the raising of the track, even though it be necessary to take down top for headroom, the water may be drained into a properly located sump and from there drained into the main drainage ditch.

Although the cost of a drainage ditch or tunnel may be considerably higher than the cost of pumps and piping, the elimination of the possibilities of flooding the mine, due to the breaking down of pumps, power plant, or other trouble; and the low cost of maintenance and operation, will often warrant the additional expenditure.

Another great advantage of the drainage ditch is the fact that it naturally possesses great reserve capacity, since to get the proper depth to bring about a gravity flow usually necessitates shooting a channel which will carry from ten to one hundred times the normal flow, whereas pumping equipment to be economical must be proportioned to the normal amount of water that is required to be removed. Accordingly a drainage ditch is an excellent insurance against a sudden influx of water from abnormal causes.

UNWATERING ABANDONED WORKINGS

It is often desirable to reopen abandoned workings which have been allowed to fill with water due to lack of pumping for several years where there is only a moderate flow under normal conditions, seasonal influx of surface water, or the diverting of drainage from other portions of the mine into same. This condition usually implies the temporary installation of a larger pump for the unwatering than is necessary for proper drainage under normal conditions.

Since water which has accumulated in abandoned workings is usually very acidulous, care should be taken in the selection of equipment to meet this condition.

Means to be employed: 1. Pumps. 2. Siphons. 3. Air lifts. 4. Water hoists.

Pumps: Where head and capacity conditions are adapted to same, a centrifugal pump is recommended due to its lightness, compactness, and the ease with which it may be installed in crowded places difficult of access. Precaution should be taken, however, to be sure that during the process of unwatering, the pump will not have to be moved sufficiently to carry the head beyond the limit

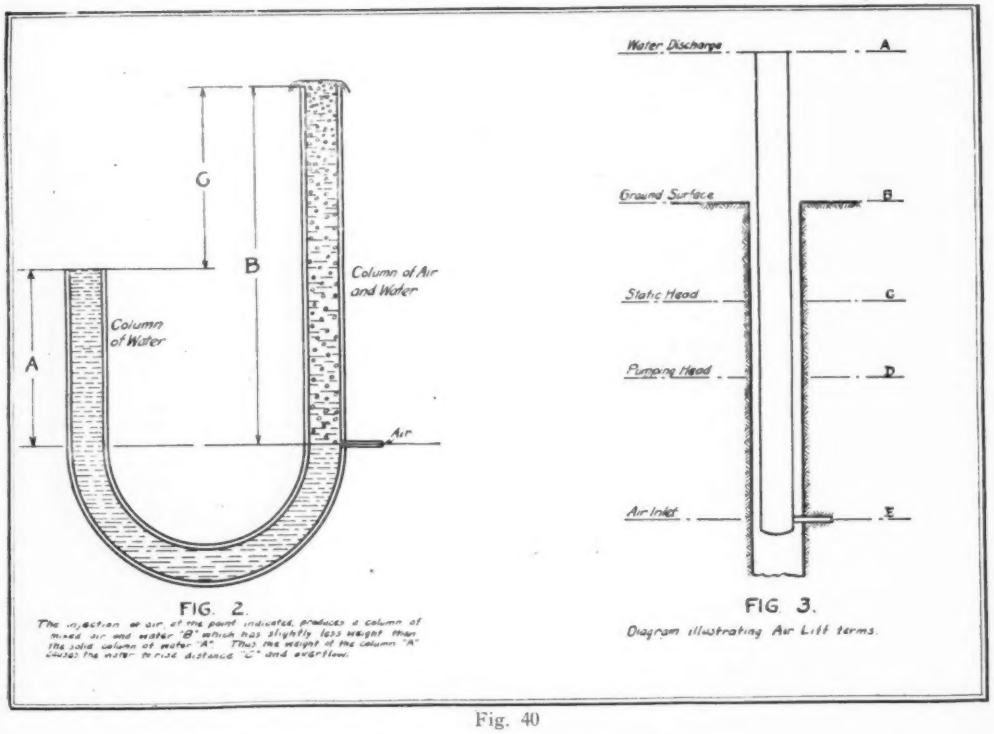


FIG. 2.

The injection of air at the point indicated, produces a column of mixed air and water "B" which has slightly less weight than the solid column of water "A". Thus the weight of the column "A" causes the water to rise distance "G" and overflow.

FIG. 3.

Diagram illustrating Air Lift terms.

Fig. 40

of flexibility of this type of pump. If a total head is reached, which renders the delivered capacity of the pump insufficient to meet the requirements a careful survey is recommended to determine:

First. Whether the installation of the booster pump at the limit of economical head of the original pump will meet the requirements; or

Second, whether the condition warrants the introduction of a positive acting pump at this time. Attention should be called to the fact that where conditions permit the use of a positive acting pump to complete this unwatering, a type of pump should be installed which may later be used in the permanent installation.

Where the water is to be lifted from a relatively deep level, reciprocating deep well pumps or vertical centrifugal pumps may be used with very good results. Practically all pump manufacturers can furnish any required data on this subject.

Siphons: The siphon is recommended for the following uses:

(*a*) Bringing water from one level to another inside the mine where ditching would be too expensive.

(*b*) Draining bodies of water which collect in low places near drift mouths, usually due to seasonal influx of surface water.

(*c*) Draining abandoned workings which have been allowed to fill up with surface water.

(*d*) Limit of the siphon. The theoretical limit to which water can be raised with a siphon is 34 feet at sea level. From 15 to 20 feet is the practical limit in mine use. The use of the siphon is not recommended where the removal of large amounts of rock or slate make the economy of the siphon as compared to mechanical pumping doubtful.

In continuous service in acid water the use of the siphon may prove more expensive than boreholes for draining the water to low levels for handling the water by pumps. Long lengths of pipe, under the corrosive action of acid mine water, mean a continual expense.

Installation of mine siphons: The following suggestions are offered for the installation of mine siphons:

1. That all joints be carefully made and all threads be examined before joining to insure as near an absolute exclusion of air as is humanly possible.

2. The use of a larger size of pipe in the suction leg than in the discharge leg, in order to lessen the resistance of the water in entering.

3. The elimination of all sharp bends on a vertical plane, which would tend to form air pockets and the laying of the siphon as nearly as possible on a gradual uniform grade.

4. Submergence of the discharge end either in a sump, small tub or barrel, or by using an elbow and nipple on the end of the discharge, the same making a right angle with the line on a vertical plane.

5. In charging the siphon it is good practice to have the charging plant at or near the high point of the discharge leg, but this is not absolutely necessary as the siphon may be charged near the suction end. It will be found good practice to tap the discharge leg at its highest point and here connect a standpipe to allow air to escape while the siphon is being charged. When all air from the siphon has been expelled the water will flow smoothly from the standpipe. When this point is reached close valve on standpipe and gradually open valve on discharge end. Siphon may also be charged by the use of common pitcher spout pump, the same placed either on the end of the discharge leg, or (where temperature conditions do not permit or it interfers with submergence) at the same point as the standpipe referred to above.

6. Actual elevations should be taken of points of intake and discharge before the use of the siphon is attempted. This may frequently eliminate the siphon from consideration.

The following is an illustration and explanation of the use of a siphon for unwatering surfaces, as given by Mr. John Brunschwyler.

"When we wish to siphon from sumps (a), (b), (c) and (d) we prime the line by pumping either from sump A or sump B, discharging at X. When the line is full the pump is stopped and valve (e) closed (near pump). The water will then automatically start to flow from the sumps (a), (b), (c) and (d). In order to regulate the flow from each sump a valve is placed on the suction line to each sump. By adjusting the valves we can siphon from all of the sumps at the same time, but ordinarily we drain from sump (a) first since it contains the most water, the valve to this sump being entirely open and the other valves adjusted so as to prevent the siphon from draining these sumps before sump (a) is drained. (See Fig. 39.)

"You will note a complication of valves around the pump; this is due to trying to siphon from sump A and discharge at X, but due to friction and elevation we were unable to accomplish this. Formerly sumps (f), (g), (h) and (i) were drained by pumping—discharging at X; and later extensions were made to discharge this water by siphon, discharging at Y. We are now successfully siphoning sump A by discharging at Y.

"When we wish to siphon sumps (f), (g), (h) and (i), we prime the line by pumping from sump B and discharging at Y. When the line is full the pump is stopped and the valve (m) is closed. The water will then automatically pick up from either of the sumps on this line. We find it best to close all the valves on the suction lines to the various sumps, excepting of course, the one to be used. Before closing the valve to a pump from which we are siphoning, and which is about drained, we gradually open another valve on the line so as not to break the flow. It is best first to drain the sump farthest away from the discharge end.

"NOTE. There is a foot valve placed on all suction lines. All pipe is 2 inches in diameter. Pump is double-acting, size 5 x 5, direct connected to a 5 horsepower motor. The standpipe near discharge end Y is used to prime the line only when the pump is out of order."

Air Lift: In places where pumps can not be used due to room available or where siphons cannot be employed, the air lift may be used in unwatering old workings. This method, while occasionally expensive in operation, may nevertheless frequently be used to advantage

and if properly understood operating expense may be kept within a very reasonable figure.

The following explanation of air air-lift system is furnished by the Ingersoll-Rand Company and shows clearly the possible application of air lift removing to unwatering operations.

"Principle of operation. By referring to Fig. 2 it will be seen that the essential principle involved is very simple, and knowing the physical principles in action, it will not be difficult to understand why the Air Lift Pump hase sometimes been charged with low efficiency which was really due to improper devices and faulty pipe proportions.

"Consider an open well, or any body of water deep enough, regardless of its volume, or what may enclose it—a pond, lake, or river being as good for our purpose as a well. In this source of supply is suspended, or fixed, a vertical pipe for water and a pipe for air. These pipes should be submerged for a certain depth, proportionate to the lift when the pump is at work. It is clear that the water, being free to enter the lower end of the pipe, will rise to the same height inside the pipe as it stands outside, and in this condition there will be nothing to cause any movement of the water either upward or downward. If we introduce air under pressure through the air pipe into the base of the water pipe, we will have an Air Lift Pump, and the principle of operation briefly described, is as follows:

"The energy operating the Air Lift is that energy in a volume of compressed air released in a fluid column in the form of bubbles at, or near the end of the submerged portion of the discharge pipe. And the driving force, causing the pump to operate continuously, is the unbalanced hydrostatic pressure in the discharge pipe resulting from a mixed column of water and bubbles of air of less specific gravity than the outside opposed column of unmodified water.

Explanation of Air Lift terms (*Fig.* 3): "Static Head. The distance the water stands normally below the surface of the ground is called the static head or normal water level. It is the distance 'B' to 'C.' Fig. 3.

"Lift. The lift consists of the static head plus the drop plus the elevation. Distance 'A' to 'D.'

"Drop. The distance the water recedes when pumping at the desired rate. Distance 'C' to 'D.'

"Elevation. The distance above the ground surface, at the well, to which it is necessary to deliver the water. This is represented by distance 'A' to 'B.'

"Submergence. Submergence is the distance the pump or foot piece is submerged below the pumping level. Distance 'D' to 'E.'

"The percentage of submergence means the percentage of the total vertical air lift column, distance 'A' to 'E,' which is submerged in the solid liquid column in the well, when pumping. Distance 'D' to 'E.'

"In practice all drilled wells present two kinds of submergence, 'C' to 'E' starting submergence, the distance the pump is submerged below the static head, and working submergence 'D' to 'E' which is the distance the pump is submerged below the pumping level.

"It will be seen that the pressure required to start the pump is greater than that required to keep it in operation, as there will be a progressive lowering of the water plane, and consequently a less head of water over the pump, until the pumping level is reached.

".434 pounds is the pressure per square inch at the base of a column of water one foot high.

"Starting pressure = Starting submergence in feet x .434 lbs.

"After the pump has started, there is a slight gain, usually neglected, due to the column of water moving at a velocity V, hence.

$$WP = \left\{ WS - \frac{V^2}{2g} \right\} .434 + F$$

where:

WP = Working Pressure.
WS = Working Submergence.
g = Gravity.
F = Friction in air.

"These variable factors, together with the quantity of water the well yields under given conditions, enters into every calculation to determine the amount of the air, the pressure required and the amount and size of the discharge and air pipes.

"The term 'head' as applied to mechanical pumps, has an entirely different meaning when referred to the Air Lift. In all forms of mechanical pumps, the total head (lift + friction) determines the pressure required to operate, while in the Air Lift the pressure required depends entirely upon the submergence, with no regard whatever to the height the water is to be elevated. This will be understood when it is realized that the pressure required to operate an Air Lift is approximately equal to the hydrostatic pressure of the water column standing over the air nozzle or pump."

Experience has taught that the best results are obtained when the submergence of 60 percent can be secured, that is when the distance from the natural outside water level to the point at which the air enters is 60 percent of the distance from the latter point to the point of discharge. The water and air can be mixed far more effectively by the use of a specially designed arrangement commonly called a foot piece or pump. There are several manufacturers of these foot pieces or pumps who can furnish useful information in regard to the applicability of the air lift to any problem in hand.

Air Pressure: The air pressure required depends first upon the depth at the point where the air enters when starting the lift and also upon the final head when maximum capacity is reached. For instance, if water is being pumped from a well 300 feet deep with the head standing entirely full at the start, if the air is to be injected at a point 300 feet from the top, an air pressure of slightly above 130 lbs. will be necessary to get the air down and into the foot piece. As soon as the water is lowered to a point 120 feet below the surface, leaving a head of 180 feet at the foot piece, a pressure of only about 80 lbs. will be required.

Amount of Air Required: The amount of air required depends upon the following:

1. The quantity of water to be delivered.
2. The depth of well.
3. The proper proportion of air and discharge pipe to the quantity of water to be delivered to keep air and water friction at a minimum.
4. The amount of submergence which is maintained. For example, if a 60 percent submergence can be maintained and with properly designed piping, the air consumption will approximate one-half cu. ft. of free air per gallon of water to be pumped. If the submergence drops to 50 percent, about .6 of a cu. ft. of air will be required per gallon of water to be pumped. With 40 percent submergence approximately 1 cu. ft. of air per gallon of water will be required.

Equipment Required: The equipment required for operating the air lift system will ordinarily include the following:

Air compressor located where the expense of attendance is least.

Air receiver with pressure gauge, safety valve, and any necessary globes and check valves to be located in a line between the compressor and receiver.

Pipe lines.

Fump or foot piece.

Supporting coupling for carrying weight of water and discharge pipe.

In some installations the use of a head piece is necessary to deflect the stream of discharge water in the desired direction.

From this explanation it is doubtless evident that there are many places where the air lift principle may be applied to advantage, even where it may become necessary to drill wells to secure proper submergence.

In mine operation the air lift may often be used to very good advantage in securing a water supply from drilled wells where the supply is abundant and submergence ample, but the well relatively small for securing by mechanical means the amount of water desired.

An air lift may also be used to very good advantage in dewatering an old mine, particularly of the shaft type where access is difficult through the regular opening. In such cases it is usually necessary to drill a well through the mine and sufficiently deep to secure the proper submergence. The air lift may also be located in one of the regular shafts and a hole drilled at the bottom of the shaft to get the proper submergence.

In installing an air lift, it is recommended that a very careful study be made of the water levels at which the lift will operate. The proper determination of these will affect greatly the operating efficiency of the lift.

The air lift principle has often been used to good advantage by connecting compressed air piping into the discharge of a centrifugal pump when the pump could not develop sufficient pressure to deliver water against the head necessary. By introducing compressed air into the discharge line the density of the water can be very materially lowered to a point where the pump will operate with effective results. This method may be frequently employed during a breakdown of a permanent station pump and to permit another pump, which ordinarily would not operate against the necessary pressure, to be used in the emergency.

Water Hoists: Water hoists are usually equipped with first motion, steam driven, double engines, although a few electric driven hoists are in service. The drums are of various sizes, shapes and arrangement, varying from 8 feet to 16 feet in diameter. Single or double cylindrical drums and single or double cylindroconical drums are in common use. The cylindrical drums usually consist of two or more cast iron or steel spiders having built-up wood faces or shells to prevent corrosion by the acidulous mine water which is carried over by the hoisting ropes.

The hoisting ropes are of crucible cast steel, 1¾ inches, 1⅞ inches and 2 inches in diameter. Extra strong crucible cast steel and plough steel ropes have been used for this service, but longer life has been given by the softer steel ropes which are not so readily corroded by the acid mine water. The hoists are of the same types as used for handling coal and are designed for a maximum rope pull of approximately 35,000 pounds.

The tanks are filled by submerging them at the bottom of the shaft, the water entering at the bottom of the tanks through clapper type valves. Emptying the tanks at the surface is accomplished by either overturning, similar to self-dumping skips, or by bottom discharge.

The water hoist method of handling mine water has been very popular in the past and is still preferred by many operators due to the fact that the mine can fill with water during flood water season and can later be de-watered.

The steam hoist engines are operated non-condensing and since they are of large size, cause heavy, sudden demands for steam on the boiler plants. Larger boiler plants must be provided and more engineers, firemen, and coal and ash handlers must be employed than would be necessary if pumps were used.

Either larger shafts are required for the operation of water hoists or separate shafts must be provided. The cost of shaft upkeep is high and tanks and ropes need frequent replacement.

The cost of operating and maintaining water hoists is so excessive that they are being replaced by large centrifugal pump stations. One of the great objections to water hoists is that the lowest level of the mine can not be worked as this section is used for water storage.

Often during the flood water periods, the coal hoists are equipped with tanks and are used to handle the excess water. This reduces coal production and further increases the cost of coal. After mines have been electrified and the water hoists eliminated, the tanks are often retained at the coal hoists and used in emergencies. This eliminates the necessity for extra column lines and pumps.

Water hoists are practically confined to the anthracite mining region, although they are occasionally used for de-watering bituminous mines. Under certain conditions their use is desirable but it is recommended that they be abandoned wherever possible in regular mine operation. On account of the heavy operating expense, the cost of changing to an efficient pumping arrangement can be soon recovered from reduced operating expense.

MINE WATER AND ITS ACTION UPON MINE DRAINAGE EQUIPMENT.—The problem of coal mine drainage varies in importance, in accordance with the conditions of the mine water at individual localities. Waters are encountered which present no further difficulty than the installation of ordinary drainage equipment, while there are some conditions which necessitate the installation of special acid resisting metals and materials, before the same can be handled with any success. For this reason it has been necessary to take careful note of these various conditions and of the nature of the waters to be handled as well as of the materials which will be suitable to withstand, for a reasonable period of time, the action of such water.

Waters from coal mines may be divided into three general classes: alkaline, neutral and acidulous, the latter class predominating. Such waters may carry either large or small quantities of mineral and abrasive matter in suspension, the amount of which is a large factor in handling the same. Alkaline and neutral mine waters are not as severe as the acidulous waters excepting where the suspended solid matter is present in large quantities. However, it is readily seen that in the former, erosion is the only action which would occur on the equipment used to handle such water, while in the case of acidulous water, carrying large quantities of abrasive matter, the two destructive agencies—erosion and corrosion—would have to be overcome. Mr. J. R. Campbell, Chief Chemist of the H. C. Frick Coke Co., has dealt extensively with the subject of acidulous mine water in his article entitled "Mine Water and Its Treatment." Quoting from this paper: "The cause of most of the trouble in pollution problems is the acid mine water drainage. There are instances in which alkaline mine water is found, due perhaps to the high alkalinity of natural waters percolating into the mine—having filtered through a bed of natural alkaline silicates." Mr. Campbell explains the source of the acidity of mine waters, as the oxidation of iron pyrite, or sulphide, into sulphates, rendering the water acid in the reaction. He here makes the point that it is the "total apparent acidity" of the salts and the acid water, "that is the most important factor in waters of this character. The free acid is a variable percentage of the total apparent acidity." Mr. Campbell asserts that a sample of water may, under certain treatment, show somewhat high alkalinity, and yet according to a determination of the total apparent acidity, be acid, for the reason that the salts do not react acid under all conditions. He cites the example of typical analysis of mine water from which we quote the relative acidity as follows:

	(Grains per Gallon)	
	(1)	(2)
Total apparent acidity	73.13	83.99
Free acidity	14.20	16.01

These important facts are generally overlooked in making examinations of mine waters and consequently the corrosive action of the same on materials for handling such water is greatly under-estimated.

Mine waters in the same locality vary largely, as do waters from different sections of the country. A number of analyses were obtained from the anthracite bituminous coal fields, of which the following are typical. Some of the most severe conditions encountered, as well as a comparatively ordinary water, as far as acid content is concerned, are as follows:

	Free Acid (Gr. per Gal)	Total Acidity (Gr. per Gal.)
*Montour No. 1	144.58	1,058.73
*Edna No. 2	186.56	956.12
*Calumet	38.48	194.14

* As given in tables of Bureau of Mines, Bull. 4, "Coal Mining Investigations."

In this table also we note the wide difference in the free acid and total apparent acidity; Montour No. 1 mine, with a lower percentage of free acid than Edna No. 2 mine, carried higher percentage of total acidity than the latter. In this same manner, the Calumet mine having a low percentage of free acid, in total acidity contains an appreciable amount for consideration.

The most severe conditions of water are encountered, according to the reports which we were able to secure, in the Pittsburgh field and in the McAlester fields in Oklahoma, though there are individual mines in Indiana and Ohio and elsewhere which have very bad water to contend with.

The amount of solid matter suspended in the water is also highly detrimental, as has been remarked, to the materials used in handling the same, as such insoluble matter is more or less abrasive. For this reason a clear acid water would be more easily handled than a nearly neutral gritty water. The combination of both is practically "disastrous" to ordinary pumping equipment, and necessitates the development of special equipment for that purpose.

The following list of mine waters presents an interesting view of the conditions found in various bituminous regions, some of them severe and others practically inactive as far as corrosion and erosion are concerned. (We call attention to the fact that these reports did not take into consideration the total acidity of the water, only noting the free acid and mineral content. We are quoting only the free acid and the total mineral solids):

Total Solids (Gr. per Gal.)	Free Acids (Gr. per Gal.)
277.33	Not given
279.90	165.60
486.40	495.00
478.99	91.96
73.93	13.67
1,078.00	303.90
37.85	.09
10.91	(Alkaline)
4.60	(Neutral)

The figures given are sufficiently representative to establish an idea with regard to the requirements of equipment which must handle such waters. Tests have been conducted during the past few years by the U. S. Bureau of Mines, pump manufacturers, and the coal mine operators, in an endeavor to solve the problem of handling the highly acidulous and gritty water.

(a) Relative Values and Resistive Properties of Metals Used in Drainage Equipment.—The most important problem involved in the manufacture and selection of such equipment outside of its simplicity of design and efficiency, are the physical and resistive properties of the metals used, for the reason that mine drainage equipment is subjected to more severe conditions because of the extremely bad water which, in the majority of cases, has to be handled. It must be borne in mind that the physical and resistive properties are almost entirely controlled by the methods employed and conditions under which such metals and alloys are produced; that is, whether they are rolled and drawn, drop-forged or cast. In any of these cases the product varies in structure and consequently in strength and reisitance to penetration, though the constituents of the alloys are the same; for example, all the metals and alloys that can be rolled and drawn or drop-forged, are more highly resistant to the attack of corrosion and erosion of mine water than similar metals and alloys when cast. In the first instance the structure

of the metal is designated as dense, or fibrous and uniform, and in the latter, granular and ofttimes crystalline and irregular. It is also for this reason that metals and alloys which are classed as acid resisting, but give a very close uniform structure, often give more satisfactory results in a mine than a highly resistant metal which has a tendency toward segregation and crystallization, permitting free access to penetration and consequently more easily attacked by corrosion. In considering acid-resisting metals or alloys in general, and especially those which have been used heretofore for equipment handling highly acidulous mine water, some of them cannot be rolled and drawn, and others cannot be successfully cast, with economy.

The following are a few of the metals and alloys which are used in mine pumps and accessories for handling acidulous mine water:

Copper	Tin	Lead	Zinc	Antimony
88	10	—	2	—
85	5	5	5	—
90	10	—	—	—
75	10	15	—	—
80	10	10	—	—
65	10	25	—	—
2	8	75	—	15
—	5	90	—	5
—	—	90	—	10

Also: High Silicon Cast Iron (14 percent Silicon or over; Carbon mostly in combined form).

High Chromium Steel and High Chromium Iron.

Some alloys containing nickel and copper in different proportions, sold under different trade names.

Owing to the low physical properties and difficulty in machining cast high silicon iron, the use of such material is limited. The physical characteristics of high chrome steel and iron make this metal practical for drainage equipment in cast form for all parts except piston rods, shafting, bolts, nuts, etc., for which parts the rolled metal should be used.

The lead base alloys, as a general rule, show a very high resistance to corrosion, but are usually low in resistance to abrasion.

The leading bronzes are used quite extensively, but when carrying more than 15 to 30 percent of lead, great care should be exercised in making castings to prevent segregation. Zinc should never be present in these alloys. Excellent results have been obtained by many such leading bronze mixtures.

Lead lined cast iron pumps are used to some extent in handling acidulous mine water, but more or less trouble has been experienced by the water seeping throu h small flaws in the lead lining. In some instances porcelain and cement have been found very satisfactory in connection with pump accessories, as well as certain types of hardened rubber. Wood piping and connections have been resorted to in instances where no other more durable material could be found; but the manufacturers are rapidly developing materials which it is hoped will meet the demands and requirements for drainage equipment, handling acidulous and abrasive waters.

(b) Recommendations of Metals and Alloys With Resisting Qualities:

1. As a conclusion of the foregoing the following metals may be recommended as highly resistant to the action of acidulous mine water:

High chrome steel and iron.

High silicon iron (silicon 14 percent and over).

Lead base alloys (of certain combination).

2. Those metals which are not as highly resistant as the former but are used to a great extent in the manufacture of pumps and accessories to handle acidulous water:

Lead bronzes.

Bronze (not containing zinc).

High nickel copper alloys (of certain combination).

3. Metals which are not suitable for drainage equipment handling acidulous water:

Grey iron, malleable iron, cast steel.

Brass or bronze (containing zinc).

German silver, any combination with copper, nickel or zinc.

Carbon and alloy steels other than the satisfactory high chrome steels aforementioned.

TABLE GIVING COEFFICIENT OF CONDITION C, FACTOR A AND CORRESPONDING YEARS OF SERVICE IN SOFT, CLEAR, UNFILTERED RIVER WATER.

C	$\sqrt[1.94]{\frac{100}{C}} = A$	Diameter of pipe in inches.												
		⅓ = 1½	2 = 3	4	5	6	8	10	12	15	20	24	30	36	42 48
		Condition of pipe.		Years of service of cast iron pipe.											
140	0.54	Very smooth and straight W. I.	Do. brass, tin, etc.	00	00	00	00	00	00	00	00	00	00	00	00
130	0.62	.....	Ordinary straight brass, tin, etc.	0	0	0	0	0	0	0	0	0	0	0	0
120	0.71	Smooth new wrought iron		4	4	4	5	5	5	5	5	5	6	6	6
110	0.84	.....		...	...	...	10	10	10	11	11	11	12	12	12
100	1.	Ordinary Wrought Iron		13	14	15	16	17	17	18	19	19	19	20	20
90	1.22	.....		...	...	...	...	...	26	27	28	29	30	30	30
80	1.52	Old wrought iron		26	28	30	33	35	37	39	41	42	43	44	45
60	2.58	.....	Very rough	45	50	55	62	68	...	...	...	...	...	...	...
40	5.46	Very rough	Badly tuberculated,	75	87	95	...	...	...	...	...	...	...	...	...

00 means Very Best and New Cast Iron Straight Pipe. 0 means Good New Cast Iron Pipe.

Explanation: For smooth new wrought iron pipe (coefficient $C = 120$), multiply values in friction table by 0.71. For old wrought iron pipe (coefficient $C = 80$), multiply values in friction table by 1.52. It must be understood that figures given are approximations only and vary with the kind of water used.

* Reprinted from "Centrifugal Pumping Machinery" by Carl George de Laval, by permission of the author and publishers.

LEAKAGE ON NATURAL GAS TRANSMISSION LINES

Large monetary losses due to leakage from natural-gas transmission lines are disclosed as a result of a survey of 26 representative transmission lines made by the Bureau of Mines in cooperation with the Natural-Gas Association of America.

Gas pipe-line operators should keep an accurate account of the amount of gas lost from their transmission systems, by making leakage tests at frequent intervals, states E. L. Rawlins, assistant natural gas engineer, in a report of the survey. Unless systematic leakage surveys are made, leaks will be present and remain undetected. For example, a leakage survey of one system of lines, approximately equivalent to 100 miles of 3-inch pipe, showed that if the leakage rate found in the survey had been the same over a period of 10 years, and gas had an average value of only 7 cents per thousand cubic feet, the accrued loss, for 10 years, with interest at 7 percent, compounded an nually, would have been $724,400. Results from leakage tests on other systems indicate that this loss could have been reduced to less than $100,000 by systematic leakage surveys and the elimination of a large part of the leakage from the system.

Leakage tests on pipe lines often reveal losses in operation that are due not necessarily to faulty construction, but to sources unsuspected by the line walker. One interesting case of this condition was noticed in a leakage test on an operating pipe-line. A gas well with a rock pressure of approximately 100 pounds per square inch was "shut off" with a gate valve from a line operating at a pressure of 250 pounds per square inch. The gate valve was leaking approximately 20,000,000 cubic feet of gas a year from the pipe line into the well.

One of the common sources of leakage is through outlet gate valves that are not bull-plugged properly. One of the principal causes for the usually large item of "unaccounted for gas" is the gas lost by excessive blowing of drips. The tests that have been made on operating pipe-lines show that a large percentage of the leakage is through screw fittings on drip connections, taps, and other connections on the lines. It is difficult to eliminate this leakage after the drips and connections are installed and the line put into operation.

The report of this experimental work is contained in Serial 2735, "The Value of Leakage Tests on Natural-Gas Transmission Lines," copies of which may be obtained from the Bureau of Mines, Department of Commerce, Washington, D. C.

THE NATION'S VIEWPOINT

A Digest Of The Expressed Opinions Of Leaders In American Affairs

CONGRESSMAN **Henry W. Watson,** *of Pennsylvania,* believes that the tariff has come to stay and that there will be no change in tariff laws during the present generation. In a recent statement on the floor of the House, he said:

"Nations are increasing tariff rates rather than reducing them, if we can be guided by commercial reports, and I doubt if lower tariff rates than now exist will be placed upon our statute books during the present generation, especially since the textile industries are building up the wealth of the southern states, changing agricultural districts into industrial sections, growing raw products on one side of the road, on the other manufacturing them into merchandise.

"I hold that a protective policy has accomplished more toward the development of our natural resources, more to increase the wealth of our Nation, more to give to our wage earners comfortable and happy homes, and more to establish our Republic as the banker of the world than any other one policy that has been adopted by the Congress of the United States. If we take time to read the speeches on tariff issues from the early period of our history to the present, we find no new arguments, whether they be on a tariff for revenue, protection, or free trade. The greatest and strongest argument that has ever been made in favor of protection can be said in three words 'Prosperity follows protection' and proven by the well-known axiom, 'Self-evident truth.'

"Protective policy made it possible to develop our industries that we could supply the world with goods. The gentlemen can not fail to admit that we loaned our allies $10,000,000,000, with the accumulating interest of two and a half billions more, to carry on the war, and our wealth made it possible to settle the war debts by discounting them more than one-half. The increase of exports that supplied the wants of the people when foreign factories were closed naturally increased our production. It was the reversed result during the 1812 war with England. We must not fail to note that the American dollar was the only medium of exchange of all the nations at war that maintained its par value. I would praise the policies that produced these conditions rather than condemn them, as the gentleman from Tennessee deems wise in his philosophy.

"Protection is as important today as at any period within the history of our Republic, in order to maintain the wages of our workmen and for the development of our country. To trace the history of tariff bills down to the present hour would be only to show that in every instance, save between 1853 to 1855 and 1872, prosperity ruled the country under protection and reversed under a tariff for revenue only. The Crimean War, between 1853 and 1855, was a blockade to im-

Wallace Press-Times

The Last Long Mile

N. Y. Evening Post

Realization

ports. The building of railroads at that period and the electric telegraph and the public lands that were developed by the pioneers, gave impetus to trade. Twenty-six thousand three hundred and forty miles of railroad were constructed between 1846 and 1860. This alone was sufficient to give prosperity to our country. There was another exception in 1872. This was a period of speculation in fanciful projects that never matured. The building of railroads into the far West, a country that had not been developed beyond the Indian trails; millions of dollars drawn into enterprises upon which no interest was paid. It was a period of promoters, the commencement of the ending of 'wildcat' schemes. The 1872 act repealed the duty on coffee, raw hides, and so forth, and reduced an ad valorem rate of 10 percent on a very large list of commodities. In 1875, 10 percent ad valorem reduction was repealed and there was immediate evidence of prosperity. Taussig remarked in his book on the tariff, 'No satisfactory investigation of the period preceding the crisis of 1873 has yet been made.' Protection also encourages competition, and competition reduces prices. Previous to the World War farm implements were cheaper than at any time within their history, and this, of course, enabled farmers to purchase them; the result, more acres under cultivation, overproduction and lower prices. Lifting the embargo of protection in order to increase the importation of grain, potatoes, and other food essentials, would further decrease the prices and again add distress to the farmer. The emergency bill, into which I have gone somewhat into detail, proves this statement.

"I favor protecting and taking care of our own people rather than those of other nations."

Declaring that the Government has no right to tax its people beyond its normal need to meet its required expenditures, Congressman **Martin L. Davey**, *of Ohio*, pointed out that:

"There is no inherent right in the power of Government to levy tax beyond its normal and proper requirements. I have been thinking in terms of those people throughout this broad land who have been bearing the enormous load, the increasing load of taxes.

"Every income taxpayer in this country and every citizen in this country who pays taxes indirectly are interested in this question of Government economy and efficiency. Every corporation, large or small, is directly interested, because this Congress is now about to pass a revenue bill which increases the corporation tax. But it is not the income and corporation tax payers alone who are concerned. Every man who buys an automobile in this country is paying a direct tribute to the waste and inefficiency in this Government. Every man who buys a car, whether it be a Ford or a Packard, is helping to keep on the pay rolls a large army of useless idlers. If it were not for this vast horde of useless loafers, this tax on automobiles could easily be abolished, and it is one of the most unjust and discriminatory taxes in all our history. Why should one great industry be discriminated against? Other taxes could be eliminated and certain other taxes could be still further reduced if we could bring about real economy and actual efficiency in the Government."

Kansas City Star

In Search of a Moses

The bill providing for the investigation of the Federal Trade Commission brought to light many congressional views as to the value of Government commissions. **William R. Wood**, *Congressman from Indiana*, is of the opinion that Congress has been in the habit of creating commissions without any thought other than their immediate usefulness. He said:

"This is another one of the evidences of the predilection of the Congress to create commissions without ever counting the cost in the present or the future. If we had followed the original design of the framers of the Constitution and had placed the responsibility in some legitimate head, then there would not have been so much complaint about these things we create in order to satisfy some spasmodic present demand or some local desire.

"If we had placed this activity under a Cabinet department where there would have been a responsible head, then the criticism would not be offered that is offered here today."

Senate bill 575 proposes to regulate railroad rates, and Senator **William B. McKinley**, *of Illinois*, on the floor of the Senate, insisted that such a bill is the most pronounced piece of class or sectional legislation that has ever been proposed in the history of the deliberations of the Senate. He further said:

"The commission is investigating the entire rate struc-

Washington Star

The Veteran

Hurrah! Eats! Wallace Press-Times

The Manicurist Wallace Press-Times

ture of the country pursuant to the Hoch-Smith resolution with the idea of seeing if it is possible to effect a reduction in rates on agricultural products. The farmers of this country will watch the vote on this bill with a great deal of interest, a bill which has the possibility of an increase rather than a reduction in freight rates on the products he has to sell. The shippers and the traffic men of the entire country, with the exception of the territory which is supposed to be benefited by this bill, are practically unanimously opposed to it, and they are thoroughly alive to the situation. They can plainly see that it is an attack upon the integrity and reputation of the Interstate Commerce Commission. They know that the bill is pointed in the direction of Government ownership and that it is nothing but an attempt at political rate making. The people of my state are waking up to the facts of the case and the public generally has a better understanding today of the dangers of this proposal than it has ever had in times past when it has come up for consideration in different forms."

Congressman **Edward E. Browne**, *of Wisconsin*, speaking in favor of the bill before Congress to settle railroad disputes, said:

"I maintain that the 95 percent human element of the transportation industry shall be made up of properly nourished, competent, energetic workers. Such workers can only be obtained through adequate wages and reasonable and safe working conditions. Such workers and such conditions are necessary for efficient and safe transportation service, which is essential to the general welfare and to national prosperity.

"I am for peace, and I am therefore for this bill, because I believe that it will promote industrial peace.

"I firmly believe in arbitration and mediation of all disputes between capital and labor. The first law providing for arbitration of labor disputes was known as the Erdman Act. This act was amended by what is known as the Newlands amendment. These laws provided for a conciliation board in cases where the railroads and the employes could not agree. These boards were very similar to the boards provided for in this bill. For 23 years, under the Erdman and Newlands acts, all grievances that could not be settled by the grievance court of the employers and employes of the railroad companies were settled by the conciliation board. During the 23 years mentioned there was not a strike on the railroads. There was not a single case where the employes refused to abide the decision of the mediation board. This certainly is a record which justifies my belief that under this bill there will be harmony between the railroads and their employes.

"This is a day of organizations. Many of the larger corporations have merged into supercorporations that control the railroads, the coal mines, the steel, lumber, and the water power of the country. Unless the laborers and the farmers of the country are highly organized they will be unable to protect themselves in the great competitive industrial life of the Nation.

"I believe in treating capital fairly. It is entitled to a fair and reasonable return on its investments, but at the same time I believe that every laborer is entitled to a reasonable wage, and I would give wages a priority over dividends, because humanity is more sacred than the dollar and because the perpetuity of our great, free institutions depends upon the prosperity and happiness of the producers and creators of wealth."

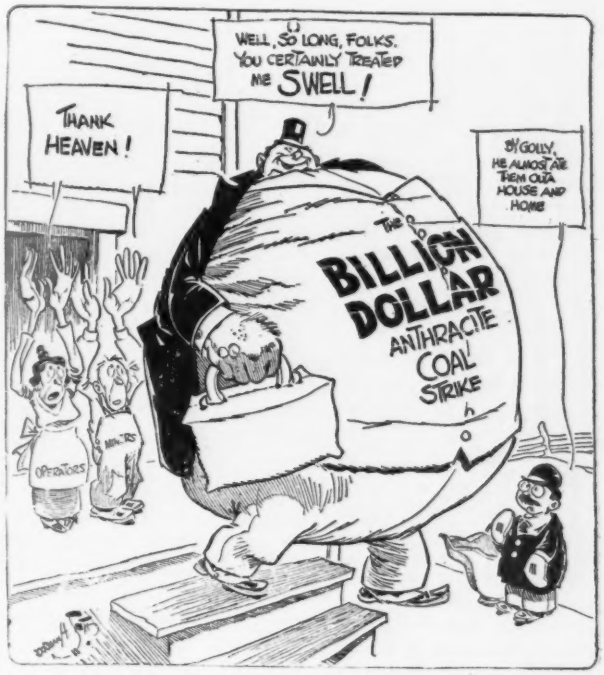
The Hon. **William N. Doak**, vice president of the Brotherhood of Railroad Trainmen, in an address delivered over the radio at Washington and quoted by Congressman John M. Robsion, of Kentucky, on the floor of the House, said:

"This plan (government ownership) should be opposed for many reasons, but if for no other because it is detrimental to the best interest of the employees.

"The proposed plan of government ownership applies not only to the railroads but also to other utilities, including coal mines, etc. If this program goes through it will ultimately be extended to the farms, mills, factories, and other industries, resulting in a supergovernment which will control all the activities of the country. This is not a theory; it is a fact in Russia, where this program is in full

Wallace Press-Times

Enough of This Nosin' Around


WELL, SO LONG, FOLKS. YOU CERTAINLY TREATED ME SWELL!
THANK HEAVEN!
BY GOLLY, HE ALMOST ATE THEM OUTA HOUSE AND HOME
THE BILLION DOLLAR ANTHRACITE COAL STRIKE
OPERATORS
MINERS

Wallace Press-Times

When It's Not Hard to Say Goodbye

force and where nationalization is fully effected."

In further discussing this subject, Congressman Robsion said:

"Public ownership of utilities is repugnant to the object and aims of our Government and will destroy the rights of our people. The interest of all employes will be jeopardized thereby. Therefore, opposition to state ownership is more than a whim; it is a solemn duty.

"Switzerland, Germany, Italy, and Austria have government-owned railroads. Railroad conductors in the United States on an average receive three and one-fifth times as much as railroad conductors receive in Switzerland; three and one-half times as much as in Germany; four and two-fifths times as much as in Italy, and about six times as much as in Austria and Hungary. Engineers, firemen, and maintenance of way men are about in the same proportion. The railroad workers of Canada received about the same wages as American railroad workers until about two years ago when the government in Canada took over the railroads. In 1924 nearly all American railroad workers received an increase in wages, but the railroads in Canada, under government ownership, had such a deficit that they did not grant any increase, and the railroad workers in America now receive much more than the Canadian railroad workers.

"With this most remarkable showing why should any one desire to have government ownership of railroads in the United States? Why try an experiment that has failed wherever it has been attempted? I wish to suggest further to the railroad workers of America, if government ownership of railroads is such a good thing for the workers, why is it that Congress must pass stringent immigration laws to keep the railroad workers on government-owned railroads in Italy, Switzerland, Germany, Austria-Hungary, and other countries from leaving their jobs and coming to America to try to take away the jobs from our railroad workers, who are employed on privately owned railroads? If it is such a good thing, why do they not stay in Europe and work on their government-owned railroads? They know that the railroad workers in America receive at least three times as much wages and have better working conditions than on any government-owned railroad in any country of Europe."

Senator M. M. Neely, *of West Virginia*, gives an interesting history of the development of the Muscle Shoals project in Congress, from the time it landed there 100 years ago until today. Mr. Neely in an address on the floor of the Senate said:

"More than 100 years ago President Monroe and his Secretary of War, John C. Calhoun, laid Muscle Shoals, like an unwanted child, on the doorstep of the Congress. Ever since the day of its entry into this body it has been a most perplexing, persistent, and pestiferous guest. During the past century Muscle Shoals has consumed the time of legislators, marred their parliamentary programs, deluded those who have desired the distribution of its power, and bitterly disappointed every farmer who has ever hoped to enrich his impoverished soil with the fertilizers which could be so cheaply made by a proper utilization of its potentialities.

"It has cost the taxpayers of the Nation, including principal and interest, at least a quarter of a billion dollars.

"Muscle Shoals has proved to be more vexatious and expensive to the American people than the plagues of the frogs and the flies and the locusts and the lice were distasteful and disastrous to the ancient Egyptians who endeavored to perpetuate the bondage of the children of Israel.

"In current slang Muscle Shoals has become as irritating and intolerable as a 'northeast blister on a southwest sore.'

"Between 1828 and 1838 the Government made a donation of 400,000 acres of public land, with the proceeds of which the State of Alabama constructed the first canal and locks at Muscle Shoals.

"In 1899 the second great improvement was completed at an additional cost to the Government of $3,191,726.50.

"In the latter part of the year 1917 the Chief of (*Continued on page* 322)

NEWS OF THE MINING FIELD

A Résumé Of The Activities Of The Mining Industry And Items Of Interest In The Field

Arizona Chapter Holds Interesting Meeting at Ray

The meeting of the Arizona Chapter of the American Mining Congress, held at Ray, March 8 and 9, is claimed to have been the best ever had by that chapter. The attendance included representatives from all of the mining districts of Arizona and from the districts near the border in Mexico. One session was given over to the presentation of technical papers regarding the interesting phases of the operations of the Ray mines. The following officials of the Ray Consolidated Copper Company read papers which were discussed by the visiting mining men: Robert W. Thomas, mine superintendent, on "Mining Methods"; Cyril A. Robotham, construction engineer, "Pneumatic Placing of Concrete"; Walter I. Garms, mill superintendent, "The Remodeled Mill Flow Sheet"; and Nels Johnson, mechanical engineer, "The Water Development."

The gathering was afforded an excellent opportunity to examine the surface and mining work and the mining methods at Ray and the reduction works at Hayden. A luncheon was tendered the visitors by the Ray Chamber of Commerce, and a dinner by Ray Consolidated.

The next quarterly meeting of the chapter is to be held in Bisbee in September at the invitation of P. G. Beckett, of the Phelps Dodge Corporation and Harry Clark, of the Calumet & Arizona Mining Company.

"Copper Committee" To Be Organized—Aim For More Efficient Methods, Lower Costs And Greater Recovery

A preliminary meeting will be held at the Michigan College of Mines, Houghton, in April, to organize a Copper Committee, similar to the Iron Committee recently formed, to direct a program of research into the problems of the copper industry in Michigan. The project is being sponsored by the College of Mines, W. O. Hotchkiss, president. April 15 has been set as the tenative date.

A general committee of College of Mines professors has been named to formulate a general plan of procedure for presentation to the mine managers, superintendents, enginers and business men of the district who are expected to attend. Among the general topics already selected as a basis of investigation by the copper committee are mining, prospecting, smelting, administration, economics and fabrication, the latter involving the feasibility of certain forms of copper manufacture in the Michigan copper industry.

The College of Mines has already done considerable research work into the physical properties of copper and the application of copper to various industries. Such facts as have been deduced will be presented to the committee. It is expected that the plan of organizaton will be similar to that of the Iron Committee and that the industry and the College of Mines will cooperate in the working out of the definite problems. The mining, prospecting, development and metallurgical branches of the industry offer a wide field for investigation and it is believed there is much to be accomplished in respect to more efficient methods, lower costs and greater recovery of values.

Utah Chapter Elects Officers—Favors Pittman Act and Bureau Plan

The Pittman bill, which directs the Secretary of the Treasury to complete silver purchases under the original Pittman Act, was unanimously indorsed at the annual meeting of the Utah Chapter, American Mining Congress, held at Salt Lake City, March 8.

The meeting also unanimously indorsed the proposal to consolidate the experiment stations of the Bureau of Mines into three stations, one at Salt Lake City, one at Pittsburgh, and one at a point to serve the oil industry, as recommended by the advisory committee appointed by Secretary Hoover.

Directors of the chapter to serve three years each were elected as follows: H. M. Hartmann, of Ophir; C. E. Loose, of Provo; J. O. Elton, W. Mont Ferry, W. J. O'Connor, D. D. Moffat, and J. W. Wade, of Salt Lake City.

At a meeting of the directors, held immediately following adjournment of the annual meeting, officers of the chapter were elected as follows: Imer Pett, governor; G. W. Lambourne, D. D. Muir, Jr., H. M. Hartmann, first, second, and third vice-governors; A. G. Mackenzie, secretary and treasurer.

United Verde Sets Off 100,000 Pounds Of Dynamite In Stripping Campaign

One hundred thousand pounds of gelatin dynamite was exploded at the shaft of the United Verde Company's mine near Jerome, Ariz., on March 2, making approximately 150,000 cu. yds. of rock available for removal by steam shovel.

The blast was carefully planned for the purpose of enabling the shovels to remove the entire overburden of the mine down to a depth of 300 feet, in order to eliminate a fire that started a number of years ago. Although intended primarily to uncover the fire zone, steam shovel operations which have been in progress for several years have proven profitable, as much valuable ore has been uncovered.

The explosives were loaded in two tunnels, so close to the fire zone that the therometer showed 120 degrees F. in the firing chambers.

Engineers to Unify Wire and Sheet Metal Gages

The elimination of the confusion caused by 30 wire and sheet metal gage systems now in use in this country is to be brought about as the result of a conference held on March 18, in New York City, and attended by representatives of 25 organizations interested in all phases of the subject, which includes wires, sheets and tubes of metals of all kinds.

Unanimous decision was reached that the confusion in the purchase and sale, and in the use of these products, brought about by the existence side by side of the numerous conflicting gage systems, has become intolerable, and that industrial practice should be unified in a simple consistent plan. The detailed technical work will be in the hands of a sectional committee broadly representing all interested industrial groups and working under the auspices of the American Engineering Standards Committee.

Addition of two companies to its membership is announced by the Copper & Brass Research Association, 25 Broadway, New York. The new members are the American Metal Co., Ltd., refiners and dealers in metals and chemicals, 61 Broadway, and the Wheeler Condenser & Engineering Co., manufacturers of brass and copper tubing, 149 Broadway, New York.

Assembling airplanes at Hudson, Ontario, which are now performing regular passenger and and express service to the Red Lake Gold district, scene of the most recent gold rush. The Red Lake district lies in Western Ontario, near the Manitoba boundary, and about 170 miles from Winnipeg. The journey from Hudson, the nearest railroad point, which at best took six days over the trail, is being made by airplane in less than two hours.

Injunction Against Nevada-Ray Merger Denied

The application to continue an injunction which since last November has tied up the meetings of the stockholders of the Ray Consolidated and the Nevada Consolidated copper companies to vote on a proposal for merger was denied March 25 in the Supreme Court at New York City.

The restraining order had been obtained by Frank C. Armstrong in behalf of himself and other stockholders of the Ray Company. Unless the court's decision is appealed the two companies can proceed with their consolidation.

The suit was brought against Charles Hayden, banker; Solomon R., Harry F., and Murray Guggenheim, D. C. Jackling, Sherwood Aldrich and others, Jackling being president of Nevada and Aldrich head of the Ray company. The Court held that the facts submitted did not justify the injunction sought and that allegations were not justified.

In concluding his opinion, Justice Levy said that the stock of each company has sold at about the same price on the market. He pointed out that the plaintiff, under the laws of Maine, where the Ray Company was organized, may have his stock appraised there at its actual value and redeemed by the Ray Company if he is not satisfied with the merger.

Court Refuses To Reopen Smelter Furnace Case For Introduction Of New Evidence

The United States Circuit Court of Appeals at San Francisco recently refused the petition of the American Smelting & Refining Company to reopen the case in which George C. Carson, holder of patents to the side method of feeding for reverberatory furnaces, won a decision. The case, originally tried in the federal court for the State of Washington and resulting in an award to Carson, was taken finally to the United States Supreme Court, which affirmed the decision of the lower court.

Evidence showing that Carson's patent, filed Jan. 15, 1907, and granted in 1915, had been antedated by operations at Dollar Bay, Mich., where from 1903 to 1906 the so-called Carson method was used and abandoned, the court refused to permit to be introduced through reopening of the suit. But it will be introduced in the Anaconda suit or in the suit against Phelps Dodge or the United Verde Extension Mining Co., which come up for hearing in the next three or four months.

Carson's share in any damages will amount to only 22½ percent of the total, that being the interest he has in the Carson Investment Co., which has taken over his patents.

Bunker Hill & Sullivan Resources Are Greatly Increased Through 1925 Developments

The extensive development work which was done during 1925 in the mine of the Bunker Hill & Sullivan Mining & Concentrating Co., at Kellogg, Idaho, greatly increased its resources, the completion of the shaft to the 1,800-foot level and the opening of the ore body at that depth adding much to the life of the mine, which is estimated in decades instead of years, according to the annual report of Stewart Campbell, state mine inspector of Idaho.

Because of the magnitude of the Bunker Hill mine the company has become more of a manufacturing than a mining corporation, and with its smelter, mills, experimental plants, and organization is one of the largest of its kind in the world.

The Tainton electro-chemical experimental plant was modified and improved and many details perfected which added greatly to the importance of the process. In addition to extensive development work in the Bunker Hill mine, the company prospected and developed other properties throughout the district.

Improvements At Durango Plant, A. S. & R. Co.

A large improvement and development program which will entail the expenditure of at least $140,000, has been started at the Durango, Colo., plant of the American Smelter & Refining Co. The program includes the addition of a Dwight and Lloyd machine in the roasting department, the installation of a reverberatory furnace, and a new handling scheme for taking care of the by-products of the plant. The new machinery will mean a bigger and better plant, and one capable of taking care of the entire mining output of the San Juan basin.

Dean G. M. Butler, of Arizona University, has announced that a special course in mine administration, limited to 12 graduate mining students who have had several years of practical experience and who are recommended for the course, will be given by the mining college of the university next fall under the direction of E. P. Mathewson, consulting metallurgist.

The Tucson, Ariz., Chamber of Mines has started work on a directory for the mines of Pima County and adjacent districts. The directory will contain a list of all mines in the district together with descriptions of the mining towns and properties and a list of the owners of claims.

Larger Amount Explosives Handled By Roads

More than 500,000,000 pounds of commercial explosives were handled by the railroads of the United States and Canada during the year 1925 without death or injury to any person, according to a report for the year of the Bureau of Explosives of the American Railway Association.

This movement of these explosives, which involves the greatest potential hazard the railroads are called upon to face, was handled in approximately 375,000 cars, but due to the excellent work of thousands of factory and railway employes it was accomplished without accident.

Two persons also were killed as the result of accidents due to the transportation of crude petroleum oil, while one fatality resulted from the transportation of Pintsch gas.

"Inflammable liquids cause the great bulk of trouble chargeable to dangerous commodities of all sorts," says the report. "Undoubtedly a far greater tonnage of all types of inflammable liquids, taken together, is hauled than of any other class of hazardous commodities and perhaps than all other classes put together. Next to gasoline, the heaviest damage is chargeable to benzol, while inflammable crude oil is third."

"Eastern Ohio Coal Operator's Association"

At the annual meeting of the Pittsburgh Vein Operators' Association, held February 24, in Cleveland, Ohio, the following officers were reelected: President, Ezra Van Horn, general manager, Clarkson Coal Mining Co.; vice-president, W. L. Robison, vice-president, Youghiogheny & Ohio Coal Co.; treasurer, H. R. Sullivan, treasurer, Central Coal Mining Co.; secretary, D. F. Hurd.

The following members were elected to comprise the executive committee: A. W. Dean, Michael Gallagher, M. B. Holdstein, T. H. Johnson, T. K. Maher, J. C. Nelms, S. H. Robbins, C. W. Troll, Whitney Warner, R. L. Wildermuth, and W. R. Woodford.

The association, which has been in existence for 24 years under the name of the Pittsburgh Vein Operators' Association of Ohio, by resolution adopted at this meeting becomes the "Eastern Ohio Coal Operators' Association."

This change in the name was made in order to properly describe the mining location of its membership and to more clearly indicate that the mine properties were located in the State of Ohio.

Enterprise Breaker Nearing Completion

Under the supervision of Superintendent S. J. Jennings, the completion of the new steel breaker at the Enterprise Colliery of the Northumberland Mining Co., Shamokin, Pa., is progressing rapidly. Modern machinery is to be installed, the coal to be prepared for market by the Chance process. The old slope on the Mammoth vein is to be abandoned and a new slope which is being sunk in the Skidmore vein substituted. Elaborate preparations for automatic turnouts, conducive to good mining practices, are under way. New tunnels are being driven to facilitate transportation.

The entire mine equipment will be changed in the course of time and modern appliances installed.

Superintendent Jennings assumed charge of the colliery some five years ago, when dilapidated conditions were displaced by a system of electrification in breaker and underground workings. Electrically operated mine pumps were installed and motored haulage. The Enterprise was the first to run electric pumps without attendants, in the region, this system having been in successful operation for the past two years.

The Enterprise Colliery was formerly operated by the late W. L. Connell, and was taken over in July of last year by the Northumberland Mining Co., of which R. H. Buchanan is president. From present indications the program of construction will be completed about June 1, and it is estimated that the output will be increased from 1,000 to 2,500 tons per day.

Anthracite Operators Elect Officers

At a meeting of the Anthracite Operator's Conference in New York City, March 18, the following officers and committees were elected for the year:

Chairman, Samuel D. Warriner; vice chairman, Daniel T. Pierce. Committee on Economics: W. H. Williams, Alan C. Dodson, Thomas Dickson, G. N. Wilson, C. S. Goldsborough. Committee on Labor: W. J. Richards, C. F. Huber, W. W. Inglis, E. H. Suender, A. M. Fine. Committee on Publicity and Education: Percy C. Madeira, W. J. Richards, Eliot Farley, J. M. Humphrey, J. L. Cooney. Committee on Public Relations: W. S. Jenney, C. F. Huber, Otis Mauser, A. B. Jessup, S. B. Thorne.

Enrollment in engineering colleges and schools throughout the United States for the school year of 1925-1926 numbers 56,332, according to a report of the Bureau of Education.

The report covers 143 educational institutions where various branches of engineering are taught. It shows electrical engineering heading the list with 18,204 students. Civil engineering is next with 12,502 while third on the list is mechanical engineering the number of students taking this course amounting to 10,662. Other courses are chemical engineering with 4,887 students, architectural engineering with 2,529 students and mining and metallurgy with 2,076 students.

Mining Companies Active in Forestry

The mining companies of Pennsylvania are among the largest planters of forest trees, and the State Department of Forests and Waters has just announced that the Clearfield Bituminous Coal Corporation, Indiana County, will plant more than 1,000,000 trees during the spring.

In addition to 949,200 trees that have been grown in the nursery operated by the company at Clymer, 80,000 trees will be procured from the nurseries of the State Department. The plan which has been prepared for this spring's planting, the department states, shows that the trees will be set out on 13 different tracts.

Mechanizing of Coal Mines Discussed by Engineers and Operators

The mechanizing of coal mines was discussed at a meeting in New York City, March 11, attended by several hundred coal operators and mechanical engineers. This topic was characterized as one of national importance, not only from engineering and operating standpoints, but also in respect to economic and social considerations. The program was under the auspices of the American Society of Mechanical Engineers, with the National Coal Association cooperating. Eugene McAuliffe, president of the Union Pacific Company, Omaha, Nebraska, presided, and addresses were made by Edwin H. Johnson, Columbus, Ohio, Graduate Research Fellow, Carnegie Institute of Technology; Col. Edward O'Toole, General Manager of the U. S. Coal & Coke Company, W. Va., and Nixon W. Elmer, Quincy, Mass.

To Reclaim Coke from Ashes

A plant for reclaiming coke from locomotive ashes is being constructed by the Boston & Maine Railroad at East Somerville, Mass. This project, so far as known, the first of its kind erected by any railroad in this country, will recover from the locomotive waste now dumped into ash heaps unburned coke which tests have shown to average from 33 to 40 percent of the ash. The B. & M. expects to recover about 30 percent by the new process.

The new plant will cover an area 30 by 100 feet. It will cost about $50,000 and will handle 2,000 tons of ashes weekly, from which approximately 600 tons of coke is expected to be declaimed.

Dust Collectors to Clarify Atmosphere

Two dust collectors, which were recently installed on chimneys of a large gas plant operated by the Municipality of Birmingham, England, each collected 49 pounds of dust per hour. This was considered so satisfactory that orders were placed for 31 additional collectors, according to a report to the Department of Commerce.

There has been considerable agitation in Birmingham, as well as in other industrial cities of England, in favor of measures designed to decrease the pollution of the atmosphere by smoke from factories and private residences. With the new collection it is said that dust will be removed from the atmosphere of Birmingham at the rate of approximately 5,000 tons per annum.

Clay Division Organized At the Bureau of Standards

A new Division of Clay and Silicate Products has been organized at the U. S. Bureau of Standards, with P. H. Bates, of Pittsburgh, as its chief. This division combines under one head all of the work of that nature which formerly was carried out by the Bureau of Mines and the Bureau of Standards. Work will be carried on at Columbus, Ohio, and Washington, D. C.

There are 26 rock-dusted mines in Indiana, according to a report received by the Bureau of Mines from Francis Feehan, Mines Safety Commissioner of the Bureau.

COAL ANALYSES REPORTS

The Bureau of Mines has recently been publishing reports containing information in regard to the characteristics of the coals mined in the various states. Each paper includes in one volume up-to-date information on the subject that has been gathered from numerous sources. Reports on the analyses of the coals of Iowa, Kentucky, Ohio, Utah and Alabama have already been issued by the bureau, while a report on the coals of Pennsylvania has been published by the Topographical and Geological Survey at Harrisburg. The seventh and eighth of this series dealing with the coals of Virginia and Missouri are reviewed below. One on Tennessee coals will be ready shortly, and reports covering all other coal producing states will eventually be published.

"Analyses of Missouri Coals"

The coal reserves of the State of Missouri before mining began have been estimated at approximately 79,000,000,000 tons. Of this amount, about one-half of one percent has been exhausted.

Missouri has four continuous workable beds, which in downward order are as follows: Lexington, Mulky, Bevier, and Tebo. In addition, there are several beds of small extent.

The Tebo bed, though locally thin, is almost everywhere present northwest of its line of outcrop and is at present mined chiefly in Linn, Grundy, Chariton, and Henry counties. The Bevier, Lower Rich Hill, or Weir- Pittsburg Lower coal, as it is variously called, is extensive and is mined at many places, yielding more than half of the coal produced in Missouri. The Mulky, Summit, and Lexington beds are relatively thin but are persistent. The Mulky bed is of most importance in Montgomery, Ralls, Audrian, Macon, Randolph, Chariton, Carroll, Lafayette, and Johnson counties, the Summit in Howard and Boone, and the Lexington in Lafayette, Ray, Putnam, and Adair counties.

At present the larger mining operations in Missouri are concentrated in such areas as are underlain by coals that are thicker or more easily mined than those found elsewhere in the area of coal-bearing rocks. In addition to the counties already mentioned, Caldwell, Callaway, Clay, Platte, Schuyler, and Vernon counties contain some thicker coal beds.

"Pocket" coals are worked in a small way in Moniteau and Cole counties and are present at a number of points in areas farther south and east. Some lignite is known to be present in the Cretaceous and Tertiary rocks of the southeastern corner of the state, but the beds have not been examined in detail and they can be only of minor importance for a number of years to come.

The paper contains chapters on the topography and geology of the coal areas of Missouri, and on mining methods practiced in the state.

"Analyses of Virginia Coals"

The Virginia coal fields are widely scattered geographically and represent deposits of widely separated geologic ages. They are known as the Southwest Virginia fields, the Valley fields, and the Richmond basin.

The Southwest Virginia fields extend in a belt along the Kentucky border southwest from West Virginia for more than 100 miles. This belt is about 30 miles wide in Buchanan county and less than one mile wide in parts of Lee county. The district may be roughly divided into two parts—the Pocahontas or Flat Top coal field at the northeast end and the Big Stone Gap coal field at the southwest end. The two fields are in many respects geologically alike.

Among the thickest and most widely mined beds in the field are the Pocahontas No. 3, Jawbone, Upper Banner, Dorchester, Imboden, and Taggart. These beds average five to 10 feet in thickness, and are worked in many of the largest mines in the state. The Pocahontas bed, which has been mined since 1882, is one of the most productive beds in the Appalachian region, but its outcrop in Virginia is limited to the northeast corner of Tazewell county.

The Valley coal fields include an outcrop of tilted coal-bearing rocks lying mainly in Montgomery, Pulaski, and Wythe counties. The beds are contained in the Price formation, which is of lower Carboniferous (Mississippian) age and is about equivalent to the Pocono sandstone of Pennsylvania.

There are several coal beds in the Price formation, but only two, known as the Merrimac bed and the Langhorne bed, have been worked commercially. The Merrimac bed is six to 12 feet thick, but includes many bony partings, and the Langhorne bed contains one to five feet of generally clear coal.

The great pressure to which the coal has been subjected has changed it at many places from bituminous to semi-bituminous, and in a few places to semi-anthracite.

The Richmond coal basin is a small area of coal-bearing Newark (Triassic) rocks that cross James River about 10 miles above Richmond.

The coal of this field has been known since 1700; is said to have been mined in 1750; and is supposed to have been the first coal mined commercially within the present limits of the United States. The coal beds have in places a thickness of about 14 feet, but most of the thicker beds contain many layers of shale and bone. The normal coal contains 30 to 35 percent of volatile matter and is an excellent coking coal. At places where it is cut by igneous dikes it has been converted to coke, and at other places it has been similarly converted to semi-anthracite.

Experiments With Wood Preservatives

During the coming summer months the United States Bureau of Mines and the Forest Products Laboratory will carry on experiments with borax and sodium chloride as a wood preservative for mine timber. The work will be conducted in cooperation with the Cleveland Cliffs Iron Co., Ishpeming, Mich., and the experiments will be done at one of the company mines in Marquette County.

Experiments have shown borax is equivalent to zinc chloride, the latter being a common preservative now used to prevent decay in timbers. Borax is expected to show up well in further tests and to greatly increase the life of mine timbers underground and retard fire.

The Cleveland Cliffs Iron Co. has for some time been operating a treating plant at the Athens mine, using zinc chloride as the preservative. Timbers treated in this plant have been placed in permanent openings, greatly reducing timber replacements in such places.

U. S. Investigating Recent Oil Mergers

Attorney General Sargent has announced that a thorough investigation into recent mergers of important companies in the oil industry involving assets of more than $750,000,000, is being made by the Department of Justice. The investigations are to determine whether the companies have violated the Serman anti-trust act by consolidating.

The mergers being probed are the joining of the Standard Oil Company of New York, a $406,000,000 corporation, with the General Petroleum Company, one of the largest of the independents with assets of $122,710,531, and the new $240,000,000 Tidewater Associated Oil Company.

Attorney General Sargent said the investigation was undertaken "in the matter of course" and as every reported combination or merger of such size as to indicate a possible violation of the Sherman anti-trust act.

University of Washington To Have Thoroughly Equipped Mining Laboratory

The State Legislature of Washington has appropriated $150,000 to complete the Mines Laboratory building at the University of Washington and to replace the mining building destroyed by fire last December. As completed, the building will be 57 by 164 feet, and four stories high. It will be thoroughly equipped for mining, metallurgy, coal washing and ceramics. In addition to providing for the college of mines the building will also accommodate the offices of the Northwest Experiment Station of the Bureau of Mines.

Surveys of Shale Lands Completed

Completion of the resurvey of two townships in the great oil-shale district in western Colorado and the acceptance of the plats by the General Land Office has been announced by the Interior Department.

The two townships are located in Garfield County. Under the Interior Department appropriation act authorizing the resurvey of the district, which contains shale deposits of potential wealth when commercially developed, eight townships are to be resurveyed in all.

Engineers of the General Land Office, according to the information made public, have practically finished the surveying work in the field, though returns of some of the townships are still in course of preparation in the Denver office of the supervisor of survey. The resurveys were necessary on account of the obliteration of considerable portions of the original surveys as well as their generally defective condition.

This oil-shale district comprises large areas in western Colorado and extends into eastern Utah. The processes of extracting the oil from these shales are not yet fully perfected, but rapid progress is being made in this direction, and the hope is that in the near future the district will begin producing wealth. Only a few years ago these lands were in a great measure considered worthless and fit for no purpose whatever.

The cost of producing a pound of copper, as estimated for mines producing over 51 percent of the copper in 1922, 1923 and 1924, was 10.19 cents a pound, according to the American Bureau of Metal Statistics. This figure covers the bare cost of production, including depreciation and with credits for gold and silver. The cost of producing over 22 percent of United States copper in these years was 12.44 cents a pound. Over 8 percent cost 13.18 cents a pound to produce, 5.45 percent cost 14.37 cents a pound and the balance cost over 16 cents a pound to produce.

Greatest Efficiency In Use Of Fuel By Railroads

Class I railroads operated their freight trains with the greatest efficiency in the use of fuel in 1925 on record, according to a tabulation of reports filed by the carriers with the Interstate Commerce Commission and made public by the Bureau of Railway Economics.

An average of 159 pounds of fuel was required in 1925 to haul one thousand tons of freight and equipment, excluding locomotive and tender, a distance of one mile. This was the lowest average ever attained by the railroads since the compilation of these reports began in 1920.

The average for 1925 was a decrease of 11 pounds under that for 1924 and was 24 pounds less than that for 1923. The volume of freight moved by the railroads in 1925 was six percent greater than in 1924 and was practically the same as that for 1923.

The reduction of 11 pounds of coal in 1925 compared with the preceding year was equivalent to a saving of more than one shovel of coal for every mile run by the average freight train.

The road locomotives of these railroads in 1925 consumed a total of 97,477,842 tons of coal, a decrease of 439,771 tons compared with the amount consumed in 1924 and a decrease of 11,997,000 tons under 1923. They also consumed 2,084,219,402 gallons of fuel oil, a decrease of 14,844,617 gallons compared with the preceding year but an increase of 104,351,402 gallons above 1923. This included fuel consumption in the freight and passenger service but does not include consumption in the yard service, shops or office buildings.

Gold From Mercury Theory Incorrect

That some one allowed his gold-rimmed glasses to touch the mercury with which Professor Miethe, of Berlin, performed his experiments of changing the atomic weight of mercury to produce gold, is the opinion of Dr. Haber, the eminent German scientist, after exhaustive tests.

Dr. Haber believes there was a trace of gold in the mercury or that it came in contact with gold before or during the electrical charges and that the theory of being able to change the atoms as advanced by Professor Miethe is totally incorrect.

Professor Miethe's new experiments, performed in the Kaiser Wilhelm Institute, have not produced the slightest trace of gold.

J. T. Terry, metallurgical engineer, of Los Angeles, Calif., has secured patent protection on a flotation process for the treatment of oxidized lead ores, including sulphates, silicates, and carbonates, involving the use of a sodium chromate treatment solution by which the lead materials are superficially converted to lead chromate and thereby rendered flotable. Mr. Terry claims that this process makes possible the treatment of many low-grade ores known to exist throughout mining districts of the West.

Gila Copper Sulphide Company

All assets of the Gila Copper Sulphide Company, whose mine is at Christmas, Ariz., were sold recently at a sheriff's sale and were bid in by attorneys for stockholders of the defunct organization for $650,000. The property has been opened up recently and is being operated for the stockholders under the supervision of F. A. Woodward, general manager of the Iron Cap Copper Company, of Globe. The sheriff's sale was resorted to as a means of reorganizing and refinancing the company.

Lumber Manufacturers At Chicago

The twenty-fourth annual meeting of the National Lumber Manufacturers' Association will be held Thursday and Friday, April 22-23, at the Congress Hotel, Chicago.

The morning of April 22 will be devoted to committee meetings, with a general program of addresses in the afternoon and an annual dinner in the evening at which those present will be guests of the National Association.

Lands Classified As Valuable In Water-Power Purposes

The Fifth International First-Aid and Mine-Rescue Contest will be held at San Francisco, Calif., during the first week of September, 1926, under the auspices of the Bureau of Mines. The date and place of the contest, which is open to all miners, quarrymen, and workers in metallurgical plants and the petroleum and natural gas industries, have been approved by the Secretary of Commerce, following an invitation received from the Society of Safety Engineers of California. The City of San Francisco has expressed its interest in the event by donating the use of the Civic Auditorium for the First-Aid Contest. The University of California has made available the use of the Greek Theater for the Mine-Rescue Contest.

The International First-Aid and Mine-Rescue contests are held annually under the auspices of the Bureau of Mines, with the cooperation of the American National Red Cross, the National Safety Council, and various mine operators' associations and miners' organizations, with the object of furthering the work of training miners in first-aid and mine-rescue methods, and the consequent advancement of the cause of safety among

the million miners of the United States.

The first-aid and mine-rescue contests will be for international championships, and international contest cups, medals and prizes will be awarded to the winner. Proficiency of contesting teams will be determined in accordance with Bureau of Mines' standards by judges thoroughly familiar with first aid and mine rescue work.

A feature of the meet will be the awarding of the Congressional medal which is given annually to the team of miners adjudged to be most thoroughly skilled in first-aid and mine-rescue methods.

Another interesting feature of the meet will be the awarding of the medals offered annually by the Joseph A. Holmes Safety Association in commemoration of notable deeds of heroism performed by miners in succoring their comrades in time of peril.

All organizations interested in the contest are invited to enter one or more first-aid and mine-rescue teams. Entry blanks, together with the general rules of the contest; can be obtained from the experiment station of the Bureau of Mines, 4800 Forbes Street, Pittsburgh, Pa.

Lands Classified As aluable For Water Power Purposes

Classification of 111,960 acres of public land in the States of Colorado, Oregon, Utah, and Washington as valuable for water-power purposes was completed by the conservation branch of the Geological Survey during the month of February, 1926, according to information made public by the Interior Department.

In addition, 4,535 acres of public land in California and Wyoming were reserved by applications filed under the provisions of the Federal water-power act. About 1,300 acres in Colorado, Oregon, and Utah were withdrawn as valuable for watering places. During the month the conservation branch also included 40,000 acres in Montana and Oregon in formal orders designating the land as nonirrigable under the enlarged homestead acts, and to that extent subject to entry as homesteads of 320 acres or less. Nearly 60,000 acres in Idaho, Kansas, and Washington were classified under the stock-raising homestead law and designated for entry in tracts of 640 acres or less. Much of the acreage involved in these designations is included in original entries or in applications under the enlarged and stock-raising homestead acts which confer a preference right.

During the month of February the Geological Survey reported on the structural relations of lands embraced in 330 applications for prospecting permits under the oil sections of the leasing law of February 25, 1920, thus bringing the number of such reports rendered since the enactment of the law to 32,879. More than 200 such applications were pending in the survey February 28, 1926. During the month reports were rendered on 27 applications for coal prospecting permits and 7 applications for coal leases, making a total of 1,688 applications for coal permits and 753 applications for coal leases reported on since the enactment of the law.

Oil Board To Make Three Separate Reports

Three reports will be made to the President and Congress by the Federal Oil Conservation Board. The first of these will deal with domestic conditions, production, refining, consumption, legal stipulations, state and national, and development of Government and private lands.

The second report will treat of the foreign oil situation as it relates to American interests. The third report will deal with possible substitutes, whether the oil shale industry can be profitably and effectively developed, whether coal can be resorted to, and whether other mineral substances can be converted to fuel uses in place of crude oil and gasoline.

It has been recommended to Congress that the original appropriation of $50,000 for the maintenance of the board be continued.

Eastern Ohio Operators Ask Union To Accept Wage Cut

Coal operators of the Eastern Ohio field have joined in the campaign to persuade the United Mine Workers of America to agree to modification of the Jacksonville wage agreement by accepting a cut in wages so that non-union competition in West Virginia and Kentucky may be met.

The James Paisley interests, of Cleveland, are said to have sent a telegram to John L. Lewis, stating that it would be necessary to close six mines of the company unless concessions were forthcoming at once.

NATION'S VIEWPOINT

(*Continued from page 317*)

directed the expenditure of $500,000 for the beginning of the construction of lock and dam No. 2.

"In February of the following year President Wilson authorized a further expenditure of $12,630,000 for the completion of this dam.

"In addition to the foregoing the Government has constructed two nitrate plants at the shoals and purchased the near-by Waco quarry for use in the manufacture of fertilizers.

"Nitrate plant No. 1, which was authorized in September, 1917, is equipped for the manufacture of gas, ammonia, ammonia oxidation, acid concentration, ammonium nitrate, and power. It cost the Government $12,887,941.

"Nitrate plant No. 2 has a capacity of 110,000 tons of grained ammonium nitrate a year. Its various subdivisions are equipped to manufacture calcium carbide, cyananimide, liquid air, ammonia gas, nitric acid, ammonium nitrate, and power. This plant, together with the Waco Quarry, cost the Government $67,555,355.

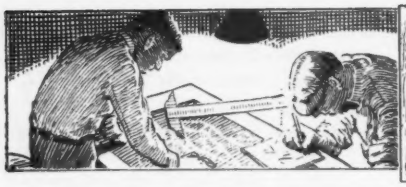
"All told the Government has already invested 400,000 acres of land and more than $122,000,000 in cash in Muscle Shoals. So far this investment has been almost entirely unproductive. It is high time that the people derive some benefit from their vast expenditures for the development of this enterprise."

When the appropriation bill carrying appropriations for the United States Bureau of Mines was before the House of Representatives, Congressman **J. Alfred Taylor**, in discussing that portion calling for an appropriation of $396,000 to be used as an investigation of the causes of falls of roof and explosions in coal mines, said:

"This is a question which should be given some scientific study by the bureau, with the hope and belief that the number of mine deaths can be greatly lessened if they are given the small sum of $15,000 with which to start the work of making a scientific investigation.

"Investigations show that the greatest number of deaths are caused by falling roofs and falling coal, and it seems to me if we can save one or two or three or a dozen lives in the next year this will be money well spent. It not only affects the great State of West Virginia, which I have the honor to represent in part, but every State in the Union where coal is produced and where there have been a large number of deaths from falls of roof and coal.

"These questions ought to be scientifically studied by the Bureau of Mines, and if we give the small sum of $15,000 with which to put three engineers in the field to visit the States where the deaths are greatest from these causes, I believe they can find a way by which they can save a great number of lives. I hope and plead with the committee to give the Bureau of Mines this small amount in order that they may have funds to study the great and important work of lessening the number of deaths which occur in the mines of our country."



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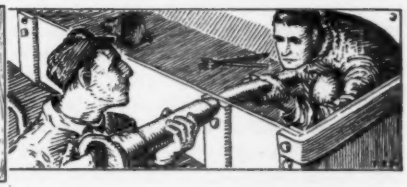

The Lighting of a Diamond Mine in South Africa

Adequate illumination at night in the Premier mines in Transvaal, South Africa, from which the record-breaking Cullinan diamond was taken some years ago, has recently been accomplished by the installation of a unique battery of incandescent searchlights.

The area with the diamond-bearing clay, the "pipe" or vent of a former volcano, is oval in shape, about 2,000 feet long and about 1,500 feet wide, or approximately a half by a quarter of a mile. This entire area of some 78 acres is being gradually dug out and transferred to the surface of the veldt, the diamonds meantime being extracted, thus leaving a great open pit, which has reached a depth of about 500 feet and which is surrounded by the harder rock of the pipe. The excavating is carried on in a series of terraces of 50 feet depth each.

At first an arc lighting system was introduced within the mine area, but the constant blasting was destructive to lamps and wiring, involving a high expense for maintenance. This was replaced some years ago by 36-inch searchlights of the arc type located along the edge of the cavity and throwing their beams downward into the mine. With each of these there was required a motor-generator set with switch gear, and an attendant to insure steady operation.

With the development of searchlights using incandescent lamps, it became possible to improve the method of lighting in a number of important details. Equipment and engineering assistance were secured from the South African General Electric Co. for a new lighting scheme, which is now meeting the situation very successfully.

Fourteen huts have been placed around the rim of the pipe, and in each is a battery of projectors containing 1,500-watt or 2,000-watt Mazda lamps with monoplane-type filaments. Each projector has a 16-inch parabolic mirror, and in front of the lamp is a 5¼-inch spherical mirror. Current for lighting the mines and works is distributed by four substations from a generating plant that contains a 1,500-kilowatt, 3-phase turbine-generator set, a 750-kilowatt, 3-phase engine set, two 350-kilowatt, 3-phase engine sets, and three 350-kilowatt direct-current engine sets.

The distances from the projectors to the surfaces illuminated range from 900 feet to 1,600 feet, and the illumination at the point of work is excellently diffused and of satisfactory volume. The economy and flexibility of the incandescent lighting presents a marked improvement over the previous arc searchlights.

It is said that there had been removed from the Premier mines, up to near the end of 1924, 102,500,000 loads of ground and that from this have been extracted 23,500,000 karats of diamonds.

Largest and Smallest Electric Locomotives in the World

There were some striking contrasts when the midget and the giant of the electric-locomotive world were compared at the East Pittsburgh works of the Westinghouse Electric & Manufacturing Co. recently.

With a capacity of 4½ horsepower, the midget serves the purpose of a mechanical mule in various mining operations.

The giant of the rails, designed for the Virginian Railway, with a capacity of 10,000 horsepower, is the world's largest and most powerful locomotive. It will be used to haul a loaded train nearly 2 miles long over one of the heaviest grades in the country.

The contrast between the Virginian electric locomotive and its smaller prototype of the industrial field is indicated by the following figures: Midget, 41½ inches long; its larger brother, 152 feet in length. Weight of midget, 1½ tons; weight of giant, 637.5 tons. Midget's drawbar pull, 400 pounds; Virginian locomotive's drawbar pull, 270,300 pounds. The smaller one derives its power from a 60-volt storage battery; the larger one from a 11,000 or 22,000 volts trolley.

Davenport Adds to Locomotive Line

A full new line of gasoline locomotives of the gear-drive type, ranging in size from 8 to 20 tons, is announced by the Davenport Locomotive Works, Davenport, Iowa.

In these locomotives geared transmission replaces the roller-chain transmission and individual wheel drive of the present Davenport gasoline locomotives, although the manufacture of the original type will also be continued.

Many new features of design and construction have been incorporated, among which is a three-point suspension principle with cross equalizer to give improved tracking qualities. Semielliptic springs have been employed because of the wider distribution of stresses and better dampening of shock obtainable with this type. A fully enclosed, roomy, all-steel cab is provided for comfort and convenience in operation.

A very open, accessible design has been used in these machines to facilitate quick adjustments and repair, and the construction is rugged and simple throughout.

Many mechanical features have been incorporated which are noteworthy. The master clutch is a step-jaw clutch which is always half way in when the faces are engaged, thus eliminating the possibility of chipped corners on the clutch faces. Reduced clearance is also made possible by this construction, which reduces backlash.

Both engine and transmission have individual force-feed lubrication systems with pressure gauges in the cab. Alemite fittings are provided for the journals at the driving wheel.

Powerful Climax engines are used—six cylinders in the 16 and 20 ton sizes and four in the 8 and 12—with four speeds forward and four reverse. Both speed and direction selection clutches slide on splined shafts for accurate, positive engagement and lock automatically in position.

The addition of this new line, together with the 4-ton Fordson-Davenport recently announced, makes the gasoline locomotive line of this company highly complete.

Link-Belt Company Announce Their New "Crawler Loader"

A new crawler loader, known as the "Link-Belt Crawler Loader," has been placed on the market by the Link-Belt Company, of Chicago.

Designed and built within the Link-Belt organization, this machine contains all the latest developments and improvements in design and detail of construction, and is said to handle crushed stone, gravel, sand, phosphate, and like materials at the rate of 1¾ yards per minute, or about 140 tons per average hour.

This new crawler loader is a one-man machine. Its driving, its operation, and its care can be handled entirely by one worker of average intelligence.

Four units compose the loader; i. e., the elevator, the chassis, the power plant, and the crawler; the unit system of construction enabling the operator to inspect the machine easily,and to make any adjustment or repair without tearing the whole machine apart.

Special attention has been given to the lubrication of all moving parts, all of which are provided with Alemite fittings or grease cups placed within reach of the operator. All bearings and moving parts are large enough to keep wear to a minimum, and give longer life to the loader.

The makers of the loader assert that anyone can learn to operate it with but a few minutes instructions. It can travel forward and reverse; and turn right or left when traveling in either direction. The starting, turning, and stopping of the Crawler Loader is all controlled by two hand levers, which automatically apply brakes when stopping. The elevator is controlled by separate hand lever, which operates a steel clutch, and disengages automatically when machine is started in reverse.

The Crawler Loader has a rated capacity of 1¾ cubic yards per minute, with uniform feed. Such a capacity means, conservatively, that about 140 tons of crushed stone, gravel, sand, phosphate, etc., can be handled per hour, under average conditions, with the loader working steadily.

The buckets used are of special design, with reinforced edges to reduce wear. They are spaced closely enough, on double strands of malleable iron and steel chain, to insure a steady delivery of material to the chute at the head of the elevator—the principle involved being that close spacing of buckets permits a lower speed of the elevator, with consequent less wear of parts.

Head and foot sprockets are made of manganese steel (which imparts extra toughness and strength, giving longer life against the wear of the materials handled), cast in two parts, and clamped on hexagonal steel shafts. This eliminates troublesome keys. The hexagonal shafts are journaled, and are run in babbitted bearings, oil-grooved, and provided with Alemite fittings. The chute at the head of the elevator, as ordinarily furnished, is of the swiveling type. It operates through an angle of 180°, and can be controlled from the operator's platform.

The feeder consists of manganese steel paddles, securely bolted to the hexagonal steel foot shaft, and so arranged as to produce a steady feed of material to the buckets. Feeder adjustment and collapsing mechanism are both controlled by a hand wheel within reach of the operator.

The chassis is made of heavy angles, plate and channels, securely riveted together, making a substantial support for elevator and machinery.

The power plant is a simple, compact, gasoline power unit of 30 horsepower at 1,200 revolutions per minute, equipped with a governor; or electric motor equipment to suit the conditions. The truck transmission has three speeds, giving a speed of 33 feet per minute or 66 feet per minute in the forward direction, and 29 feet in the reverse.

The machinery housing is a specially designed unit, housing all driving and control machinery for crawler and elevator. All shafts are of turned steel, all gears cut steel, and all bearings bronze-bushed. This housing is dust-tight, and partly filled with oil, which assures sufficient lubrication to all parts.

The drive from engine to machinery housing, and drives from machinery housing to crawler, are all roller chains, running on steel sprockets. All drives are protected by sheet-steel guards.

The crawler is of channel and plate construction, riveted together, making a rigid housing for sprockets and idlers. The sprockets are of the Link-Belt patented self-cleaning type, made of steel, bronze-bushed. The treads are made of special heat-treated steel, cast in one piece, 11 inches wide, 11 5/16-inch pitch, and run on cast-steel idlers, also bronze-bushed, with large chambers for lubrication. Alemite lubrication is used throughout. A special design of shoes and sprockets guarantees self-cleaning crawler traction tread. And, finally, the rollers are large in diameter, and keep the bearings up out of the dirt.

New Anaconda Hoists

Six new electric hoists, three of which will be among the largest ever made, are to be installed by the Anaconda Copper Mining Co. in connection with the extension of three of its Butte mines to a depth of 5,000 feet. This company is now mining ore to a maximum depth of 3,200 feet. It is probable that seven additional mines will be extended to this depth later.

The three mines to be equipped with new hoists will be those known as the Badger State, the Mountain Consolidated and the Belmont. Each shaft will be equipped with two hoists, one a main ore hoist and the other an auxiliary hoist. Hoist equipment for two of the shafts will be furnished by the General Electric Co. and the Nordberg Manufacturing Co., while the third shaft will be equipped by Allis-Chalmers.

A review of the G. E.-Nordberg equipment indicates a number of interesting features. The two main hoists involved will be designed to operate from a maximum depth of 5,200 feet with skips normally operating in balance. The weight of ore handled per trip in the skip will be normally 7 tons, and the maximum rope speed 2,250 feet per minute.

Each of these two hoists will consist of a double-clutched drum, 12 feet in diameter, and driven by a direct-current motor having a normal continuous rating of 2,150 horsepower at 59.5 revolutions per minute and with a temperature rise not exceeding 40° C. This motor will be direct connected to the drums through a solid coupling. The hoists will be arranged to operate in balance from various levels, this being made possible by the use of drums made loose on the driving shaft and capable of being clutched to it in any desired position.

Ward Leonard control will be used. The motor generators furnishing the direct current will consist of 2,300-kv-a., 514-r.p.m., 2,200-volt synchronous motors, 1,650-kilowatt, 750-volt (maximum) direct-current generators and 63-kilowatt exciters. The hoists will be manually controlled through a master switch controlling the voltage from the generator. An unusual number of safety features will also be provided.

Each of the G. E.-Nordberg auxiliary hoists will be operated by similar electrical equipment, each hoist motor having a normal continuous rating of 1,050 horsepower at 59.5 revolutions per minute and with a temperature rise not exceeding 40° C. The same method of control will be used on these as on the main hoists. Instead, however, of using skips, the auxiliary hoists will use three-deck cages, each capable of holding a 900-pound car containing 1,800 pounds of ore or rock. The maximum rope speed will be 1,500 feet per minute. A single 8-foot drum will be used.

The G. E. main hoist motors will be among the largest in physical dimensions ever built, being practically the same size as that installed at the Inspiration Copper Co., Miami, Ariz., which is the largest single-motor hoist in this country.

Across-the-Line Starters Easily Accessible

The Westinghouse Electric & Manufacturing Co. is manufacturing two new types of across-the-line starters, the reversing and the nonreversing types, that are neat and compact in design, and are easily accessible for installing and wiring. Two slotted hexagonal screws firmly hold the starter unit in place in a sheet-steel cabinet. Thus the starter may be taken out as a unit by merely removing these two screws with an ordinary screwdriver, leaving all the room inside the cabinet for attaching conduit bushings and drawing in the leads.

The starter, consisting of a three-pole contactor with electrical interlock, is completely enclosed and is operated entirely from a push-button station located conveniently. In this way it provides safe control and eliminates damage which may be caused by tampering, or by unskilled handling. In addition to this safety feature, a floating armature type, three-pole contactor is used that provides smooth and positive contact. It is quiet in operation and the contactors tips are kept clean by the rolling and wiping

action in closing, thus preventing the tendency to heat or weld under load.

Where the operating conditions necessitate the protection of the starter against an accumulation of chips or other foreign matter, a door interlock may be had that makes it impossible to start the motor unless the cabinet door is fully closed.

McKinley Loader Does Well in Test

According to an announcement of E. S. McKinlay, of the McKinlay Mining & Loading Machine Co., Pt. Pleasant, W. Va., in a recent test at the Jenkinjones Mine of the Pocahontas Fuel Co., the McKinlay machine advanced the heading at the rate of six to seven inches per minute, mining and loading the coal automatically at the rate of one ton a minute from the face of the coal into the mine cars. This entry was 5½ feet high and 10½ feet wide. It was driven without explosives or timber and an estimate of from 50 to 60 percent lump coal was made by those watching the operation. The vein is thick enough to operate a larger size machine, so that the makers are confident that the ultimate speed of the machine for headings in this grade of coal will exceed 100 feet an 8-hour shift.

Central Steel Co. Opens Tulsa Office

Owing to the ever-increasing demand for Agathon alloy steels, and to render better service throughout the oil fields of the Southwest, the Central Steel Co., of Massillon, Ohio, has opened a district sales office at 404 West First Street, Tulsa, Okla.

This office will be in charge of Mr. L. S. Allen, who has not only gained a first-hand knowledge of steels through his connections with eastern mills but also knows the steel requirements of the oil fields as a result of his many years of contact with the oil-drilling industry. The services of Mr. Allen, backed by a large staff of expert metallurgists and the facilities of the Central Steel Co.'s extensive mills, are ever at the command of southwestern industries.

E. O. Shreve, manager of the San Francisco office of the General Electric Company since 1918, has been named manager of the industrial department of the company with headquarters at Schenectady, filling the vacancy caused by the recent death of A. R. Bush.

The Chicago & Eastern Illinois Railroad has placed an order for 500 coal cars with the Mt. Vernon Car Manufacturing Co.

General Electric Suggestion Awards

Awards totaling $38,938 were paid 3,433 employes of the General Electric Co. during 1925 for suggestions made by workers which improved working conditions or tended to increase the efficiency of the company's operations.

During the year 11,325 suggestions were offered, of which more than 30 percent were accepted. During the previous year 12,217 suggestions were made and 26 percent accepted, and in 1923 but 21 percent of those offered were accepted.

The awards, which ranged up to $500, were paid at the option of the recipient either in cash or G-E Employes Securities Corporation bonds, which yield 8 percent so long as the original holder remains in the employ of the company.

Goulds Pumps, Incorporated

Effective April 1, the name of the Goulds Manufacturing Company, Seneca Falls, N. Y., will be "Goulds Pumps, Incorporated." There is no change in organization, business policy or ownership. The board of directors, officers, managers and personnel remain the same. In 1869 when the company was incorporated as the Goulds Manufacturing Company, they built a wide variety of products. Today they have but one product—pumps, and they have considered it a great advantage to link their product with the name.

Ellis Mill Patents Declared Valid

The district court for the southern division of Northern California on March 16 declared valid the Ellis Mill patents of the Ellis Mill Company of San Francisco. The victory Ball Mill and similar mills were found to be an infringement of their patent. A permanent injunction was granted the Ellis Mill Company against the K. & K. Machinery Company offering them for sale.

Burt Fleeger, treasurer, sales manager, and a director of Sivyer Steel Casting Company, Milwaukee, has resigned, to become associated with Oklahoma Steel Castings Company of Tulsa, Okla., as vice president.

Mr. Fleeger, who has been with the Sivyer organization since 1913, has acquired a substantial interest in the Oklahoma company and will be located in Tulsa after March 25.

The Oklahoma Steel Castings Company is preparing plans for an extensive addition and is purchasing more equipment, which will materially increase its capacity of electric steel castings, of which it is the largest producer in the Mid-Continent fields.

Announcement has been made of the appointment of Harlan A. Pratt as manager of the Oil and Gas Engine Department of the Ingersoll-Rand Company. Mr. Pratt was connected for many years with the Sales Department of the Westinghouse Electric & Manufacturing Company, later becoming Sales Manager of the Atlantic Elevator Company, exclusive agent in the East for Westinghouse Gearless Traction Elevators. For the past three years he has been Sales Manager of the Elevator Supplies Company, of Hoboken, N. J.

Mr. Pratt is a graduate of Stevens Institute of Technology, and a former Director of the American Institute of Electrical Engineers.

Recent purchases of equipment for the operation of the Susquehanna iron mine of the Susquehanna Ore Co., at Hibbing, Minn., on the Mesabi Range, include two type 120-B electric Bucyrus Company's shovels. The 120-B electric type of shovel promises a number of advantages over the prevailing railroad type shovel, generally conceded the most satisfactory for loading of direct shipping ore.

E. I. du Pont de Nemours & Co., of Wilmington, Del., has recently issued a "Blaster's Handbook" of nearly 200 pages, 4 x 6¾ inches, completely indexed, and full of information concerning the use of explosives. It was prepared under the direction of Arthur La Motte, manager of the technical section of the du Pont Co., and describes and illustrates practical methods of using explosives for various purposes.

A recently issued bulletin of the E. J. Longyear Co., diamond drill explorers, mining development contractors and geologists, shows the character of diamond drill work and mining in nonmetallic fields undertaken by the company. The bulletin is No. 26 and is well illustrated and interestingly written.

The Davenport Locomotive Works, Davenport, Iowa, have published a circular carrying a description and full specifications of their new 4-ton gasoline locomotive, known as the Davenport-Fordson. The locomotive has a speed range of 3 to 14 miles per hour, with three speeds provided for in reverse, as well as forward operation. Its maximum tractive power is 2,125 pounds. Copies of the circular will be sent upon request to the company.

The Griscom-Russell Co. has removed its general offices from 285 Madison Avenue, New York City, to the new Murray Hill Building, at Fortieth Street.

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ACETYLENE GENERATING APPARATUS
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

ACID, SULPHURIC
Irvington Smelting & Refining Works, Irvington, N. J.

AERIAL TRAMWAYS
American Steel & Wire Co., Chicago and New York.

AIR COMPRESSORS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.

AUTOMATIC CAR CAGES
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

AUTOMATIC FEEDERS, GRAVITY
G. M. Johnson Mfg. Co., Jeannette, Pa.

AUTOMATIC (Mine Doors, Truck and Electric Switches)
American Mine Door Co., Canton, Ohio.

AUTOMATIC SWITCH THROWERS
G. M. Johnson Mfg. Co., Jeannette, Pa.

BATTERIES (Storage, Gas Welding, Cutting, Dissolved Acetylene)
Prest-O Lite Co., 30 East 42nd St., New York City.

BATTERY SCREENS
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

BEARINGS (Roller)
Hyatt Roller Bearing Co., Harrison, N. J.

BELTING (Conveyor, Elevator, Transmission)
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

BELTING, SILENT CHAIN
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

BINS (Coke and Coal)
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

BIT SHARPENERS
Ingersoll Rand Co. 11 Broadway, New York City

BLACK DIAMONDS
R. S. Patrick, Sellwood Building, Duluth, Minn.

BLASTING POWDER
E. I. du Pont de Nemours & Co., Inc., Wilmington, Delaware.
Hercules Powder Co., 934 King St., Wilmington, Del.

BLASTING SUPPLIES
E. I. du Pont de Nemours & Co., Inc., Wilmington, Delaware.
Hercules Powder Co., 934 King St., Wilmington, Del.

BLOWERS, CENTRIFUGAL
Ingersoll-Rand Co., 11 Broadway, New York City
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

BLOWPIPES, Brazing, Carbon Burning, Cutting, Lead Burning, Welding, Welding and Cutting
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

BREAKERS (Construction and Machinery)
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

BUCKETS (Elevator)
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

CABLES
American Steel & Wire Co., Chicago and New York.

CABLES (Connectors and Guides)
American Mine Door Co., Canton, Ohio.

CABLEWAYS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

CAGE (Safety Appliances)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

CAGERS, AUTOMATIC
G. M. Johnson Mfg. Co., Jeannette, Pa.

CAGES
Allis Chalmers Mfg. Co., Milwaukee, Wis.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
G. M. Johnson Mfg. Co., Jeannette, Pa.

CARBON AND BORTZ
R. S. Patrick, Sellwood Building, Duluth, Minn.

CARBON BURNING APPARATUS
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CARBON RODS AND PASTE FOR WELDING
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

CAR HAULS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, O
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

CAR WHEEL BEARINGS
Hyatt Roller Bearing Co., Harrison, N. J.

CASTINGS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CHAIN RAIL CAR HAULS
G. M. Johnson Mfg. Co., Jeannette, Pa.

CHAINS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

CHAINS, AUTOMOBILE ENGINE
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, COAL CUTTING
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CHAINS, DRIVE
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, FRONT END
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, OILING
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CHAINS, POWER TRANSMISSION
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Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

CLAMPS (Trolley)
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Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
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COAL COMPANIES
General Coal Company, Land Title Bldg., Philadelphia, Pa.
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Thorne, Neale & Co., Philadelphia, Pa.
Bertha-Consumers Company, Chamber of Commerce Bldg., Pittsburgh, Pa.

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The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
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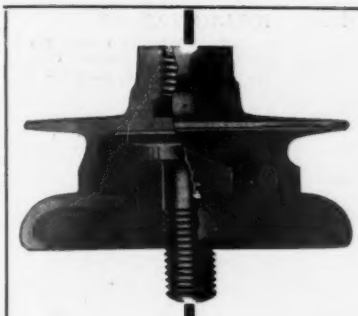

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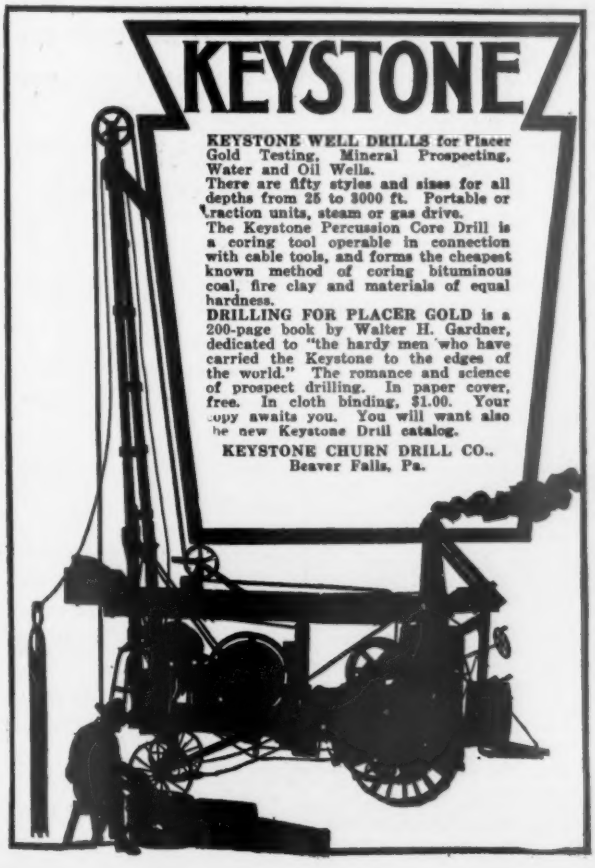

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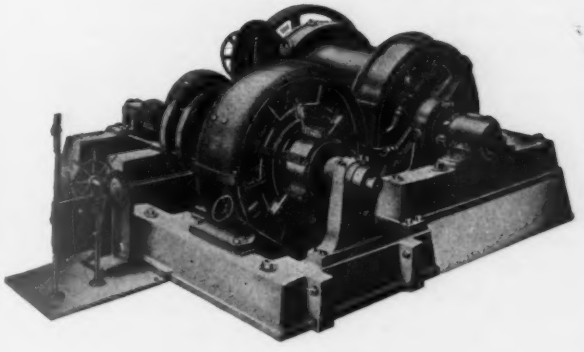

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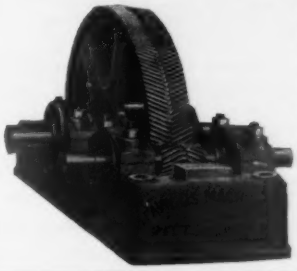

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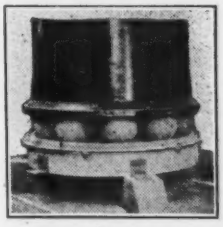

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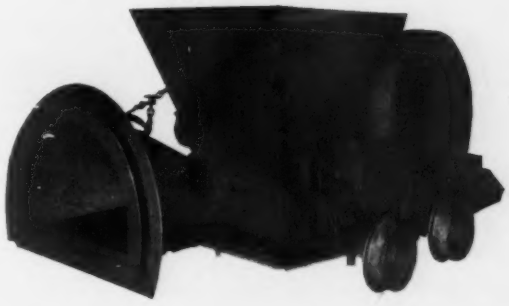

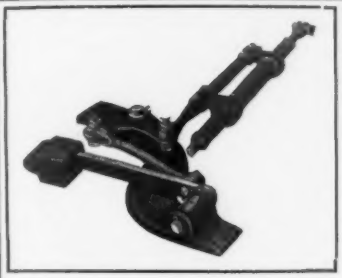

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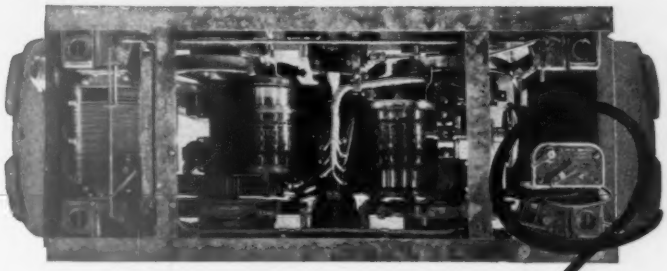

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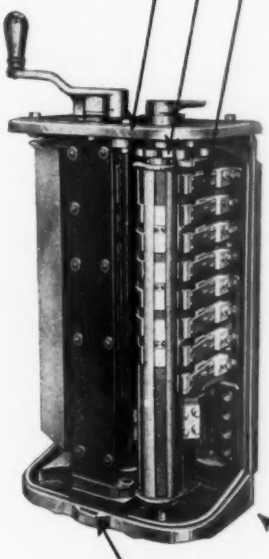

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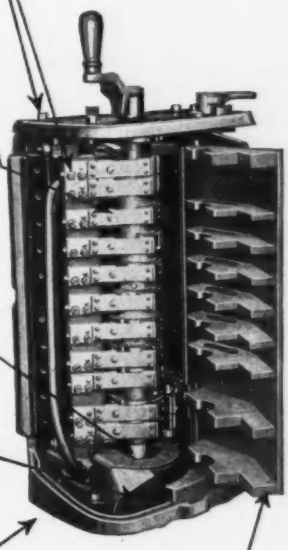

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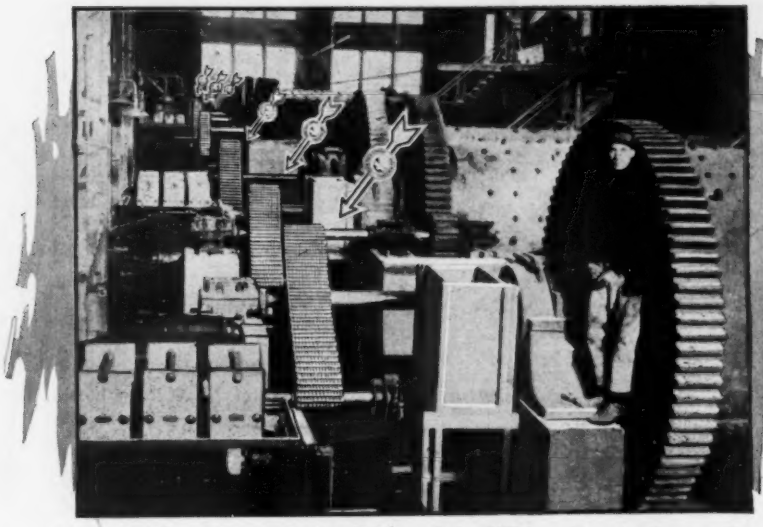

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